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FIRST ANNUAL REPORT

for the Fishery Management Plan for the

PELAGIC FISHERIES OF THE WESTERN PACIFIC REGION
COVERING 1987 AND EARLIER YEARS

MAY 1989

Prepared by the Plan Monitoring Team
for the
WESTERN PACIFIC REGIONAL FISHERY MANAGEMENT COUNCIL

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GLOSSARY OF TERMS

Abundance The number of fish of a species present in an area of interest over a specified unit of time.

Catch The number or weight of a particular species or group of species taken in a unit of time, whether retained or landed.

Catch-Per-Unit of-Effort (CPUE) Generally defined as the average catch taken by a defined unit of fishing effort. For PMUS, CPUE will be calculated as the weight of pelagic species landed per unit of effective effort.

Catch Rate See CPUE

CNMI Commonwealth of the Northern Mariana Islands.

DAWR Guam Division of Aquatic and Wildlife Resources.

DFW Commonwealth of the Northern Mariana Islands Division of Fish and Wildlife.

DMWR American Samoa Department of Marine and Wildlife Resources.

Effective Effort An effective fishing trip for each species or species category appearing in tabular summaries is defined as a trip which resulted in the landing of that species or species category. For purposes of calculating CPUE, effective effort for any species or species category is defined as a trip which resulted in the landing of any PMUS or tuna.

Effort or Fishing Effort A numerical measure of the amount of gear and time used in an attempt to catch fish. Effort may be expressed in terms of number of hooks fished per day, number of boat days, man hours, line hours, etc.

Exclusive Economic Zone (EEZ) U.S. waters from the seaward boundary of a State or Territory to 200 nautical miles from the shoreline.

Fishery A fishery is a composite of the following essential components: a resource consisting of a population of a species or set of species usually with similar ecological requirements or characteristics; a number of fishermen who regularly exploit the resource, together with their boats and equipment for harvesting and handling fish; and a market in which fishermen can sell their catch.

Fishery Management Plan (FMP) — A plan prepared by the Council and implemented by the U.S. Department of Commerce for the conservation and management of fishery resources in the Exclusive Economic Zone.

HDAR — Hawaii Division of Aquatic Resources, Department of Land and Natural Resources.

Magnuson Fishery Conservation and Management Act (MFCMA) — Federal law (P.L. 94-265, passed in 1976 and amended several times in subsequent years) covering fishing activity in U.S. waters between State waters and 200 nautical miles from the coastline.

Management Unit — A species or a group of fish species affected or exploited by the same fishery or fisheries.

Maximum Sustainable Yield (MSY) — The greatest average amount, in theory, that can be harvested from a population of fish on a continuing basis.

Mortality — Refers to the death rate in a population from natural and fishery causes. Together these constitute total mortality. Mortality rates can be considered on an instantaneous or an annual basis (instantaneous mortality rates are the limits approached by average rates over progressively shorter periods).

NOAA Fisheries — The National Marine Fisheries Service, located within the National Oceanic and Atmospheric Administration, has the primary Federal responsibility for the conservation, management, and development of living marine resources and for the protection of certain marine mammals and endangered species under numerous Federal laws. The Agency also has responsibilities to the U.S. commercial and marine recreational fishing industry, including fishermen, and to the States and the general public.

Northwestern Hawaiian Islands (NWHI) — The Hawaiian Islands archipelago lying to the west of 161° 20' W. longitude.

Optimum Yield (OY) — The amount of fish which produces maximum benefits to the Nation, especially considering food production and recreational opportunities.

Overfishing A term often used to describe fishing at a level of effort in excess of the level needed to obtain the MSY. The term is also used to imply that fishing has reduced stock to such a level that its reproductive potential is reduced. Overfishing may occur in a fishery at different levels of effort for recreational and commercial users. This may occur, for example, when recreational users prefer fish of smaller size than commercial users.

Plan Monitoring Team (PMT) A team appointed by the Council to monitor the fishery and to prepare annual reports under the direction of the Council. The PMT utilizes inputs from all committees and panels as well as outside sources in developing the annual reports.

PMUS Pelagic management unit species are those species covered by the Council's Pelagics FMP. They are listed in the introduction.

Stock A population or portion of a population that can be treated as a single unit for management purposes.

Western Pacific Regional Fishery Management Council (Council) The Western Pacific Regional Fishery Management Council consists of public and private members from the State of Hawaii, the territories of American Samoa and Guam, and the Commonwealth of the Northern Mariana Islands and members from Federal Agencies. It has authority over the fisheries in the Pacific Ocean seaward of the jurisdiction of such State, territories, Commonwealth, and possessions of the United States in the Pacific Ocean area out to 200 nautical miles from shore.

INTRODUCTION

The Fishery Management Plan (FMP) for the Pelagic Fisheries of the Western Pacific Region was implemented by the National Oceanic and Atmospheric Administration's National Marine Fisheries Service (NOAA Fisheries) on March 23, 1987. The Western Pacific Regional Fishery Management Council (Council) developed the FMP to manage the pelagic fishery resources covered by the Magnuson Fishery Management and Conservation Act of 1976 which occur in the fishery conservation zone off the coasts of American Samoa, Guam, Hawaii, and U.S. possessions in the western Pacific (fishery management areas). The management goal of the pelagic FMP is to maintain pelagic stocks at optimal population levels while managing foreign fishing, promoting equitable domestic utilization of the resources by commercial, subsistence, and recreational sectors, eliminating waste from incidental harvest, and diminishing the risk of gear conflicts.

The pelagic management unit species (PMUS) covered by this FMP are given below:

Common Name	Scientific Name
Mahimahi (dolphinfish)	*Coryphaena hippurus*
Pompano dolphinfish	*C. equiselis*
Wahoo	*Acanthocybium solandri*
Indo-Pacific blue marlin	*Makaira mazara*
Black marlin	*M. indica*
Striped marlin	*Tetrapturus audax*
Shortbill spearfish	*T. angustirostris*
Swordfish	*Xiphias gladius*
Requiem sharks	Carcharhinidae
Thresher sharks	Alopiidae
Hammerhead sharks	Sphyrnidae
Mackerel sharks	Lamnidae

PMUS are generally caught by trolling and using tuna longline gear in pelagic waters, particularly in oceanic waters but in insular areas as well. Most of these species are considered to be epipelagic because they occupy the upper most layers of the pelagic zone. All are high predators in the trophic sense. Pelagic fisheries, for PMUS and tunas, are generally the most important components of many Pacific island fisheries.

The pelagic FMP requires that the Council's Pelagic Plan Monitoring Team (Team) prepare an annual report on the status of the pelagic fisheries taking place in each of the island areas served by the Council and evaluate the effectiveness of the FMP in meeting its goals and objectives. The following outline of the required contents of the annual report as given in the FMP will be used to assess the status of the pelagic fisheries in each of the four western Pacific island areas (American Samoa, Guam, Hawaii, and Northern Mariana Islands).

Fishery Performance Data
Biological Data
Enforcement Activities and Problems
Plan Administration

Research Results
Problems Requiring Council Consideration and Action
Assess Effectiveness of Monitoring Procedures
Recommended Actions
Appraisal of Impacts of Recommended Actions

Information to meet these reporting needs was provided by the following agencies: NOAA Fisheries Southwest Region including its Southwest Fisheries Center Honolulu Laboratory (Honolulu Laboratory) , Office of Law Enforcement, and Pacific Area Office; State of Hawaii Division of Aquatic Resources (HDAR), Department of Land and Natural Resources; the Territory of American Samoa Department of Marine and Wildlife Resources; the Territory of Guam Division of Aquatic and Wildlife Resources; and the Commonwealth of the Northern Mariana Islands Division of Fish and Wildlife. Fishery statistics included in this annual report are derived from commercial landings information rather than catches obtained from logbooks. The term catch rate will actually refer to landings divided by units of fishing effort. Statistics for recreational fishing are not included in this report unless landings enter the market place. In addition, a statistically designed survey is used to collect data on all Guam marine fisheries, but these data were not analyzed for inclusion in this report, nor have they been compared with the commercial data.

The Team intends to base its annual report on modules submitted by the agencies listed in the above paragraph. However, for this first report, NOAA Fisheries Honolulu Laboratory was asked to prepare computerized procedures for use by the island fisheries offices in future years and to prepare the first data summaries. A computer programmer was contracted by the Council to code the procedures developed by the NOAA Fisheries Honolulu Laboratory. Documentation of this project and the resulting data summaries are contained in Skillman and Tokunaga (1988).

ASSESSMENT OF MONITORING PROCESS

This being the first annual report, a number of problems occurred which the Team intends to rectify in the second report due in June 1989. The Council provided programmatic funding for a computer programmer to work with NOAA Fisheries in preparing computerized procedures for the preparation of island specific report modules. Data reports were completed for American Samoa, Guam, and Northern Mariana Islands, but while procedures were prepared for Hawaii, they could not be implemented in time for including summaries in this report. The Team expects to be able to include summaries for Hawaii in the second report. Through an oversight, procedures were not included for plotting the tabulated effort statistics; this problem will be corrected before the June 1989 report is due.

Fishing effort was defined in terms of fishing trips because this statistic was available for all four island areas. Effort in units that are probably more closely related to the mortality caused by the fishing gear, for example hours fished, are available for some data sets. The use of these other definitions and their impact on indices of abundance should be investigated and could be added to the proposed programmatic project involving computation of catch rate.

Catch rates were not presented in this report because of problems in selecting which measure of fishing effort to use. This situation will be remedied and statistics will be included in the June 1989 report.

Size composition data were not included in the report because data sets containing such information are not organized and readily available for analysis. The Team expects that considerable progress will be made on this matter during 1989, but summaries will probably not be available for inclusion in the June 1989 report. While existing data will be cataloged and described, descriptive statistics prepared and estimates of vital parameters probably made, additional data will be required, particularly for Guam and Northern Mariana Islands, to monitor the fishery for mahimahi and other resources.

All data included in this report are derived from commercial landings information. In Guam, survey data are available that encompass commercial, recreational and subsistence fishing. It would be desirable to work up these statistics and compare trends based on the commercial statistics; but the Team has set no timetable for doing this.

FISHERY PERFORMANCE DATA

I. AMERICAN SAMOA FISHERY

The American Samoa fishery operates primarily around the main island of Tutuila and the Manu'a Islands and is carried out primarily from small catamarans, called alias, and manta cats making 1-2 day trips. Department of Marine and Wildlife Resources staff obtained data from 1982 to September 1985 by attempting to interview each boat operator at dockside at the time of landing. However, a complete enumeration of each landing was not obtained. The fisheries staff enumerated the number of trips taken by each commercial vessel and used each vessel's average landings per trip to estimate total annual harvest for each vessel. The sum of the estimated landings for all vessels was then divided by the sum of all documented landings to create an expansion factor for estimating total catch by species. These expansion factors were used to raise the tabulated amounts by simple, direct proportion. Starting in October 1985, the data were collected using a survey design employing subsampling and statistically based expansion algorithms for the Tutuila fishery and by continuing the enumeration for the Manu'a fishery.

1. Total Catch, Foreign and Domestic, by Species and Gear

No licensed foreign fishing under the FMP has taken place since the plan came into effect; hence, there are no data to summarize. Since only domestic landings data are collected, they will be referenced below.

2. Total Landings and Estimated Revenues by Species and Gear

Total annual landings (reported in pounds) by species and species categories as well as by fishing methods (gear) are given in Appendix I for 1982-87. Comparable tabulations by month are available in Skillman and Tokunaga (1988; Appendix F).

3. Fishing Effort

Fishing effort was estimated in terms of the effective number of trips on which each individual species (or species mixture, e.g. marlins), and species category (such as total PMUS) was landed. That is, an effective trip for a particular species (or species category) is defined as a fishing trip which resulted in the landing of said species (or species category). Effective trips estimated on an annual basis are given in Appendix I while monthly statistics are available in Skillman and Tokunaga (1988; Appendix F).

4. Annual and Quarterly Catch Rate by Species and Gear

Skillman and Tokunaga (1988) calculated catch rate on annual and monthly bases measured in terms of landings per effective trip (as defined in the above paragraph). Since this is a biased measure of abundance, the Team suggested that catch rate be calculated where an effective trip is defined as a trip that catches any PMUS or tuna, as Skillman and Kamer did in a billfish assessment done for the Council in 1985. Hence, no catch rate statistics are included in this first annual report.

5. Relationships Among Fishery Sectors

5.1 Species Categories

The annual landings of PMUS and Pelagics-Misc. in American Samoa are small compared to other species categories (Fig. 1); 1985 and 1986 were the two best years for PMUS with landings amounting to approximately 16,000-17,000 pounds and valued at about $24,500. The annual landings of "Tunas Total" and "All Others", a non-pelagics category, have fluctuated substantially over the years, but on average landings for these two species categories are about equal (Fig. 1). However, in terms of annual revenue the "All Others" category comprises the most important segment of the Samoa fishery (Appendix I). This situation is due to the generally higher price of bottomfish (the major component of the "All Other" category), especially for those exported to Hawaii.

5.2 Fishing Methods

Trolling has been the most important method of fishing for PMUS with tuna longline fishing contributing significantly to the fishery in 1984 and 1985 (Fig. 2). Annual landings for the mixed gear category, trolling and bottomfish fishing, which was created in 1985 to deal with trips on which both fishing methods were employed, has accounted for on average approximately 10% of the landings.

6. Species Composition

Using the statistics for trolling gear, mahimahi annual landings exceed those for the other PMUS in all years but 1984 (Fig. 3). Landings of billfishes and wahoo rank second and third, respectively. Landings of shark have been minor.

7. Trends

7.1 Landings

The relative contribution of the fisheries for PMUS, tunas, misc. pelagics, and others (Fig. 1) has not changed materially over the years, except for the low contribution of tunas in 1982 and the high contribution of Pelagics--Misc. in 1984. Landings for all fisheries in 1987 declined substantially compared to the previous 3-4 years; the number of boats and the number of trips made in catching bottomfish also declined substantially (Bottomfish Plan Monitoring Team 1988) and this probably holds true for pelagic fisheries as well.

With respect to trends in fishing methods used in harvesting PMUS, trolling has clearly been the most important method employed over the years (Fig. 2). A domestic tuna longline vessel operated only for 2 years but did contribute significantly to the landings in those years. The relative importance of the combined trolling-bottomfish fishing method was highest in 1986, but clearly, more than three years of data are needed to discern a trend.

Mahimahi annual landings increased steadily from 1982 through 1986, and then declined sharply in 1987 (Figs. 3 and 4). Wahoo annual landings increased from 1982 to 1983 and then increased again from 1984 to 1986 (Fig. 3). However, a long-term plot of monthly landings indicates that there have been possibly two episodes of increased landings: one extending from late 1983 to late 1984 and a second starting in late 1985 and ending (or decreasing) in 1987 (Fig. 5).

Landings of billfishes have been sporadic over the years with highs occurring in 1984 and 1986 (Figs. 3 and 6); however, the trend was upward until 1987.

7.2 Fishing Effort

Annual effective fishing effort statistics on the basis of each individual species or species category have been computed (Appendix I), but these statistics have not been plotted because of methodological problems.

7.3 Catch Rate

To be reported on in the next annual report.

8. Seasonal Patterns of Fishing

Since the landings in American Samoa, particularly of PMUS, are small, monthly averages are quite variable and can be strongly effected by unusual vessel landings (outliers in the statistical sense). Average monthly landings (1982-87) for the fishery categories indicate only slight seasonality (Fig. 7). PMUS landings are largest in late austral winter to spring months although January landings are on a par with those in July. For the Pelagics-Misc. category, landings increase in March-July, but the largest average landing occurred in October. Landings of tunas increase in October-January, but the largest average landing occurred in June. Landings of the species category All Others decline in the austral winter.

Monthly landings of mahimahi averaged over the 6 years of available data are larger from July through October while billfish average monthly landings are lowest during this period and highest from November through June (Fig. 8). The long-term plot of monthly mahimahi landings for surface trolling does not show an annually occurring seasonal pattern typical of the fisheries in more temperate waters (Fig. 4). The long-term plot of monthly billfish landings is equally variable (Fig. 6). Wahoo landings are variable but showing increased landings from October-February (Figs. 8 and 5).

9. Size Composition

Size composition statistics were not available at this time for compilation and are excluded from this report.

II. GUAM FISHERY

Guam commercial landings are made up of landings by full-time and part-time commercial fishermen and subsistence or recreational fishermen selling a portion of their catch. Different segments of the fishery employ essentially the same type of boats, namely small, powered runabout craft. Fishing takes place around the island of Guam and in the southern reaches of the Northern Mariana Islands. The statistics used in this study are collected by Honolulu Laboratory from wholesale dealers including the Guam Fishermen's Coop. They represent a complete enumeration of the landings passing through recognized wholesale sites, but represent an unquantified proportion of the total commercial landings (Hamm indicates that it may be from 40-80%, personal communication). The data do not include estimates from either the inshore or offshore, creel census surveys conducted by the Guam Department of Aquatic and Wildlife Resources. Fishing method was not recorded until 1982.

1. Total Catch, Foreign and Domestic, by Species and Gear

No licensed foreign fishing under the FMP has taken place since the plan came into effect; hence, there are no data to summarize. Since domestic landings data are collected, they will be referenced below.

2. Total Landings and Estimated Revenues by Species and Gear

Total annual landings (reported in pounds) by species and species categories as well as by fishing methods (gear) are given in Appendix II for 1979-87. Comparable tabulations by month are available in Skillman and Tokunaga (1988; Appendix G).

3. Fishing Effort

Fishing effort was estimated in terms of the effective number of trips on which each individual species (or species mixture, e.g. marlins) and composite species category (such as total PMUS) was landed. That is, an effective trip for a particular species (or species category) is defined as a fishing trip which resulted in the landing of said species (or species category). Effective trips estimated on an annual basis appears in Appendix II while monthly statistics are available in Skillman and Tokunaga (1988; Appendix G).

4. Annual and Quarterly Catch Rate by Species and Gear

Skillman and Tokunaga (1988) calculated catch rate on annual and monthly bases in terms of landings per effective trip (as defined in the above paragraph). As noted above, the Team recommended an alternative means for calculating the statistic.

5. Relationships Among Fishery Sectors

5.1 Species Categories

On average, the annual landings of PMUS are larger than the landings of tunas, All Others, and Pelagics-Misc. categories (Fig. 9). The greatest landings of PMUS occurred in 1983 (approximately 173,000 lb. with revenues of $237,000) while that for tunas and the "All Other" species category occurred in 1984. Landings of the Pelagics Misc. Total species category were insignificant.

5.2 Fishing Methods

Fishing method was unspecified in the early years, but, thereafter, the most important fishing method has been trolling (Fig. 10). Landings by ika shibi (tuna night handline) and tuna longline fishing occurred but were small (Appendix II). However, it must be noted that after 1982, data records for pelagic species which did not identify the method of fishing were edited to trolling whenever possible based on the best available information about the fisherman making the landing. Likewise, when data records with pelagic landings were found with fishing methods other than trolling, ika shibi, and tuna longline, they were edited to have trolling as the fishing method. These edits were not a common occurrence.

6. Species Composition

Annual landings of mahimahi and wahoo have generally ranked either first or second among the PMUS; on average mahimahi annual landings exceed that for wahoo (Fig. 11). Billfish landings rank third in importance.

7. Trends

7.1 Landings

The PMUS fishery expanded from 1979-86 with a record run (of mahimahi) occurring in 1983 (Fig. 9). Landings for tunas followed a similar trend, but fell off after 1984. In contrast, landings of the All Other species category remained at low levels from 1979-82, increased substantially in 1983, and declined after 1985 (Fig. 9). The landings for the fishery category, Pelagics-Misc., were insignificant.

Once specific fishing methods were recorded, trolling has clearly been the dominant fishing method for PMUS (Fig. 10). Landings by ika shibi and tuna longline fishing methods were recorded only in 1982, and the landings were negligible (Appendix II).

Annual mahimahi landings have been variable over the years and have shown a generally increasing trend (Fig. 11). The long-term plot of monthly mahimahi landings (Fig. 12) indicates that the length of the season has significantly affected the total annual landings. Landings after 1983 are larger than for prior years. Landings of wahoo have increased relatively steadily from 1979-85 before declining somewhat (Fig. 11). The large wahoo landings in 1983

and 1986 seem due primarily to increased landings during the fall (Fig. 13). Annual billfish landings have expanded moderately through the entire time series, probably due to increased charter boat fishing and sales of recreationally caught fish. This fishery has been less variable relative to those for other species (Fig. 11).

7.2 Fishing Effort

Annual effective fishing effort statistics on the basis of each individual species or species category have been computed (Appendix II), but these statistics have not been plotted in time for inclusion in this report.

7.3 Catch Rate

To be reported on in the next annual report because of computer and methodological problems.

8. Seasonal Patterns of Fishing

The seasonal nature of the Guam fisheries for the different species categories is clear (Fig. 15). Average monthly landings of PMUS are greater from January-May while landings for tunas and the "All Others" species category (mostly bottomfish) have been greater in the summer months. Landings of Pelagics-Misc. show little evidence of seasonality.

From Fig. 16 it is apparent that the seasonality of the combined PMUS fishery is a reflection of the seasonality of mahimahi landings. The regular nature of the mahimahi fishery can be seen in the long-term plot of monthly landings (Figs. 12). From the chart of average monthly landings, the fishery for wahoo appears to exhibit a bimodal seasonality with peak landings occurring in March and November (Fig. 16). However, the long-term plot of monthly landings suggests a winter run with peak landings sometimes occurring in early or late winter, or both (Fig. 13). The billfish fishery follows a summer seasonality (Fig. 16), and the seasonality appears to be consistent over years (Fig. 14).

9. Size Composition

Size composition statistics were not available for compilation. The computer contractor who assisted with preparing this annual report will be used to address the size composition issue.

III. HAWAII FISHERY

The Hawaii fishery operates around the seven main Hawaiian Islands of Hawaii, Maui, Lanai, Molokai, Oahu, Kauai, and Niihau, off the banks, atolls, and islets comprising the Northwestern Hawaiian islands, and in waters outside the FCZ surrounding the Hawaiian Archipelago. The fisheries are quite diverse ranging from recreational and subsistence fishing through small scale commercial fishing to large scale industrial ventures. The vessels employed in the fisheries vary from rubber skiffs through powered runabouts to large, modern fishing vessels; spotter planes are used in some fisheries. About 50% of the commercial

landings are made on Oahu and about 35% occur on Hawaii.

According to the State law (Hawaii Revised Statutes 189-2), any person who takes marine life for commercial purposes or who provides vessel charter services for taking marine life must have a commercial marine license. The Department of Land and Natural Resources' Division of Aquatic Resources (DLNR) has collected statistics on the commercial fishery since the late 1940's; today the data collection system is based on the monthly submission of Fish Catch Reports which require daily catch information from fishermen with commercial marine licenses. For the most part, fisherman report the amount landed and sold or the amount landed with the intent of selling, rather than the amount actually caught. Correspondingly, the reported dates are the date of landing, whether for single-day trips or, frequently, for trips
lasting more than one day.

1. Total Catch, Foreign and Domestic, by Species and Gear

No licensed foreign fishing under the FMP has taken place since the plan came into effect; hence, there are no data to summarize. Regarding domestic fishing, the data are, for all practical purposes, landings data and as such will be referenced below.

2. Total Landings and Estimated Revenues by Species and Gear

Data compilations comparable to those produced for American Samoa, Guam and Northern Mariana Islands, that is of landings in pounds, revenue, and fishing effort by PMUS and species categories, by fishing method, and by annual and monthly time periods have not been completed. Comparable statistics, though not including fishing effort, are available in Hamm and Kassman (1986) and Hamm and Quach (1988). The following data summaries were taken from Pooley (1988) and charts are also included from Hamm and Quach (1988). Annual summaries of billfish, mahimahi and wahoo combined, and tuna landings in pounds from 1970-87, based on HDAR statistics, are available in Table 1. For 1987, landing statistics (pounds landed, pounds sold, revenue, and price) for PMUS and tunas based on HDAR statistics are presented in Table 2. Also for 1987, estimated landings of PMUS and tunas derived from Honolulu Laboratory market surveys are presented in Table 3.

3. Fishing Effort

Fishing effort statistics appropriate for computing catch rate have not yet been compiled.

4. Annual and Quarterly Catch Rate by Species and Gear

The statistics necessary for estimating catch rate have not yet been compiled.

5. Relationships Among Fishery Sectors

5.1 Species Categories

The annual landings of PMUS in Hawaii fall well below those for tunas but on a par with those of bottomfish management unit species (Fig. 17).

5.2 Fishing Methods

Based on both HDAR and Honolulu Laboratory market statistics, trolling, pole-and-line, tuna longline, and handline fishing methods each contributed approximately 20% of the PMUS and tuna landings in 1987 (Table 3). Trolling was the most important method of fishing for mahimahi, contributing approximately 80% of the landings in both sets of statistics. For billfish, Honolulu Laboratory statistics have tuna longline gear and trolling contributing 51% and 46% of the landings, respectively, while the HDAR statistics show 15% and 79%. This discrepancy is thought to be due to under-reporting of tuna longline vessels in the HDAR statistics. However, tuna longline and trolling account for 33% and 19% of the tuna landings in HDAR estimates and 22% and 20% in Honolulu Laboratory estimates. The relative importance of various gear types, using 1987 market statistics, for PMUS and tunas is shown in Fig. 18; trolling is the most important fishing method for mahimahi, wahoo, and blue marlin while tuna longline is most important for striped marlin and large tunas. The commercial pole-and-line fishery is clearly the most important fishery for skipjack tuna.

6. Species Composition

Based on HDAR statistics, combined landings of mahimahi and wahoo are now the most important component of PMUS landings with blue marlin landings coming in a strong third (Fig. 19). Landings of billfish exceed the nearly equal landings of mahimahi and wahoo (Fig. 21). Landings of striped marlin and other PMUS are relatively small (Fig. 19). Based on Honolulu Laboratory market data, billfish landings exceed those for mahimahi and wahoo; other pelagic landings were small (Fig. 21).

7. Trends

7.1 Landings

The contribution of the PMUS fishery to pelagic landings has increased relative to the tuna fishery, primarily due to the decline in skipjack tuna landings (Fig. 22). Relative to the landings of yellowfin and bigeye tunas, PMUS landings have remained about on par, and all have increased. During 1979-84, PMUS landings were comparable to those for bottomfish management unit species (Fig. 17).

Landings of mahimahi and wahoo have increased substantially from 1970-87 and dramatically since 1984 (Figs. 20 and 22). Landings of billfish declined at the start of this time series, increased from 1972-78, declined again until 1985, and then increased again in the last two years of the time series (Fig 20). Striped marlin landings have declined over the years to quite low values, but under-reporting by longliners would strongly affect this trend.

Other billfish landings have remained fairly low.

7.2 Fishing Effort

These statistics have not yet been compiled.

7.3 Catch Rate

These statistics have not yet been compiled.

8. Seasonal Patterns of Fishing

Average monthly landings of PMUS and tunas both show increases during the summer months, particularly for tunas; average monthly landings of bottomfish management unit species are highest in the winter months (Fig. 23).

Wahoo, blue marlin, and swordfish average monthly landings show an increase during the summer season (Figs. 24, 25, and 26). The mahimahi fishery shows a bimodal pattern with high average monthly landings in February-May and September-December (Fig 24). Average monthly landings for striped marlin, spearfish, and sailfish are higher in spring or early summer (Figs. 25 and 26).

9. Size Composition

Size composition statistics are not available for compilation, but will be included in later annual reports.

IV. NORTHERN MARIANA ISLANDS FISHERY

The Northern Mariana Islands commercial fishery operates primarily around the main islands of Saipan, Rota, and Tinian. The fishery is conducted with small outboard-powered, runabout boats making almost exclusively one day trips. The size of the fleet has increased in recent years. Trolling is the primary fishing method employed, but fishing gears for taking bottomfish and reef fish are also employed. The Division of Fish and Wildlife has been collecting fishery statistics on the commercial fishing fleet located on Saipan since the mid 1970's, primarily by collecting data at points of sale.

An unresolved political disagreement exists between the Commonwealth of the Northern Mariana Islands and the U.S. Government as to the applicability of the Magnuson Act to the EEZ surrounding the CNMI. So, although the pelagic resources of the CNMI are not technically covered by the FMP, at least until the situation is settled, to provide a complete picture of pelagic fisheries in the western Pacific, CNMI data will be included along with that of Guam, Hawaii and American Samoa.

1. Total Catch, Foreign and Domestic, by Species and Gear

No licensed foreign fishing under the FMP has taken place since the plan came into effect. No foreign data exist to summarize. Only domestic landings data are collected, and they are referenced below.

2. Total Landings and Estimated Revenues by Species and Gear

Total annual landings (reported in pounds) by species (or species categories) and by fishing methods (gear) are given in Appendix III for 1979-87. Comparable tabulations by month are available in Skillman and Tokunaga (1988; Appendix H). Data for January-May 1980 are missing.

3. Fishing Effort

Fishing effort was estimated in terms of the effective number of trips on which each individual species (or species mixture, e.g. marlins), and species category (such as total PMUS) was landed. That is, an effective trip for a particular species (or species category) is defined as a fishing trip which resulted in the landing of said species (or species category). Effective trips estimated on an annual basis are given in Appendix III while monthly statistics are available in Skillman and Tokunaga (1988; Appendix H).

4. Annual and Quarterly Catch Rate by Species and Gear

Skillman and Tokunaga (1988) calculated catch rate on annual and monthly bases in terms of landings per effective trip (as defined in the above paragraph). However, the Team recommended that to get a less biased measure of abundance, catch rate should be calculated where an effective trip is defined as a trip that catches any PMUS or tuna. Hence, no catch rate statistics are included in this first annual report.

5. Relationships Among Fishery Sectors

5.1 Species Categories

Annual landings of PMUS have been relatively low and exceed only those of the species category Pelagics-Misc. (Fig. 27). In contrast, annual landings of tuna and the category All Others have been at substantially higher levels. On average, species category rankings are tunas, All Others, PMUS, and Pelagics-Misc.

5.2 Fishing Methods

Fishing method is not determined from the purchasers of fish and is recorded as unspecified. However, it is known that trolling is the only method capturing significant quantities of PMUS.

6. Species Composition

On average the rank of species contributing to the landings of PMUS is mahimahi, wahoo, billfish, and sharks (Fig. 28). While annual mahimahi landings generally exceed those of wahoo, landings of wahoo on occasion rank first. Billfish landings have been low while shark landings are insignificant.

7. Trends

7.1 Landings

All interpretations take into account that data for 1980 are low because data for January-May are missing. The annual landings of PMUS have exceeded only those of the Pelagic-Misc. species category and have stayed relatively stable (Fig. 27). Landings of Pelagics-Misc. show little trend. In contrast, the landings of tunas and the category All Others have expanded considerably from the 1979-80 period, though there is some sign of a decline recently.

The annual landings of mahimahi have remained at about the same level from 1979-87 although considerable fluctuation has occurred (Fig. 28). Wahoo landings increased until 1985 when they reached the same level as those of the mahimahi fishery; fluctuations of these two species seem out of phase. The magnitude of the billfish landings has not increased over the time period, but the last year of essentially zero landings was 1982. Averaged over the period 1979-87, the order of importance of the species landings is mahimahi, wahoo, billfish, and shark (insignificant). The long-term plots of monthly landings do not show an increasing trend for mahimahi (Fig. 29), but do for wahoo and marlin (Figs. 30 and 31).

7.2 Fishing Effort

Annual effective fishing effort statistics on the basis of each individual species or species category have been computed (Appendix III), but these statistics have not been plotted.

7.3 Catch Rate

To be reported on in the next annual report.

8. Seasonal Patterns of Fishing

Average monthly landings indicate that January-April is the best season for PMUS although there is an increase in October as well (Fig. 32). The tuna fishery exhibits a seasonality with higher landings from April through the summer months and lower landings in the winter. The landings of the species categories Pelagics-Misc. and All Others show little evidence of any seasonality (Fig. 32).

From the plots of individual PMUS (Fig. 33), it can be seen that the January-April PMUS season is due to the landings of mahimahi while the fall season is due to the entry of wahoo into the fishery. Landings of billfish increase from June-September but are still small. Shark landings are too small to discern any seasonality. The long-term plot of monthly landings shows that the seasonal run of mahimahi has been quite regular; data are missing in 1980 when the mahimahi run occurs. (Fig. 29). Comparable long-term plots of monthly landings of wahoo and marlin (Figs. 30 and 31) show much more variability in the seasonal pattern apparent in the average monthly plots (Fig. 33).

9. Size Composition

Size composition statistics are not available for compilation, but will be included in later annual reports.

ENFORCEMENT ACTIVITIES, PLAN ADMINISTRATION, AND PROBLEMS

I. Administrative Activities

In calendar year 1987 a total of nineteen permits were issued to foreign longline vessels for the western Pacific pelagics fishery. This was significantly less than the 97 permits issued in 1986. All of the permits issued in 1987 were to vessels of South Korea. As in 1986, there were no requests by foreign longline vessels to enter the EEZ for fishing purposes in 1987.

In March 1987 the Fishery Management Plan for the Pelagic Fisheries of the Western Pacific Region (FMP) went into effect and established a new management regime for pelagic fisheries in the EEZ surrounding Hawaii, Guam, American Samoa and the U.S.possessions. The FMP replaced the PMP for Pacific billfishes, sharks, wahoo and mahimahi which was first implemented in 1980. The EEZ around the Commonwealth of the Northern Marianas Islands and off the west coast of the United States (excluding Alaska)was not included in the FMP. Accordingly, foreign fishing for pelagic species in these waters continues to be governed by the provisions of the PMP.

The FMP prohibits foreign longline vessels from fishing within certain closed areas of the EEZ and designates other areas of the EEZ as retention and non-retention zones for the purpose of regulating the foreign catch of pelagic species. The FMP also establishes a triggering mechanism for broader area closures,requires foreign longliners to file effort plans and retains several operational requirements of the PMP related to permits, observers, record keeping and reporting. The FMP expressly prohibits the use of drift gill nets in the EEZ but provides for possible use of drift gill nets by domestic vessels under an experimental fishing permit (EFP).

In March 1987 an application for an EFP to carry out drift net fishing in the EEZ around Hawaii was submitted to the NMFS Southwest Regional Director by a domestic fisherman. After thorough review of the application and public comments on the application the Council recommended the permit be denied. The Regional Director accepted the recommendation of the Council and denied the permit citing the lack of suitable accommodations for an observer and the potential threat posed to protected species and non-tuna fishes important to established fisheries in Hawaii.

II. Enforcement Activities

U.S. Coast Guard aircraft and surface vessel patrol activities in the EEZ for 1986 and 1987 are described in detail in Table 4. In 1987 Coast Guard C-130 aircraft logged 295 hours of foreign fisheries patrol covering 67,089 miles. Surface vessels patrolled the EEZ for 105 days covering 22,227 miles. Throughout 1987 a total of 36 foreign fishing vessels were sighted (Table 5).

No citations were issued for illegal fishing in 1987.

RESEARCH RESULTS

I. NOAA Fisheries

1. Stock Assessment of Pacific Billfishes

With the increasing importance of recreational fishing for billfishes worldwide, interest in the biological status of billfish stocks has heightened. Thus, organizers of the Second International Billfish Symposium, held in Kailua-Kona on 1-5 August 1988, requested that the status of Pacific billfish stocks be updated. The first attempt at assessing the status of the billfishes on a Pacific wide basis occurred at a workshop held in Honolulu in 1977 (Shomura 1980), and Indian Ocean billfish stocks were included in a 1979 stock assessment workshop held in Shimizu, Japan (FAO 1980).

The paper, "Status of Pacific billfish stocks", by Robert A. Skillman, which will be published in the Proceedings of the Second International Billfish Symposium, contains surplus production model assessments, using geographic index areas for computation of indices of stock abundance, for Indo-Pacific blue marlin, swordfish, and sailfish/shortbill spearfish combined. No attempt was made to fit the model to black marlin data nor to sailfish and shortbill spearfish separately because of data problems. Specifically, black marlin catch data did not appear to vary as a function of fishing effort. Also, in the case of sailfish and spearfish, the size and placement of the Food and Agriculture Organization of the United Nations (FAO) fishery statistical areas made it impossible to artificially divide the total catch statistics for these two species based on knowledge of species distribution. Also, no satisfactory fit could be obtained for striped marlin because of the linear nature of the relationship between catch and fishing effort. Average weight statistics, computed from reported logbook numbers and FAO weight statistics, did not always follow expected trends, particularly for striped marlin where the computed average weight has increased throughout the history of the fishery. The effect of deep longline gear was simulated using assumed 25% and 50% reductions in the effective catch rate for billfish.

In general, the status of billfish stocks has improved in the latter part of the time series, from the late 1970's to 1980, as estimated total effective fishing effort declined. This was true particularly under the assumption of declining overall gear effectiveness with the more widespread use of deep tuna longline gear. The generalized production model of the blue marlin indicates that the harvest of this species still exceeds the estimated maximum sustainable yield (MSY) of approximately 23,500 metric tons (t), but that the situation has improved with the use of deep longline gear (Fig. 34A). For shortbill spearfish and sailfish considered as a unit, the generalized production model assessment indicates that the combined species stocks are being harvested about at MSY, estimated to be approximately 9,900 t (Fig. 34B). However, plots of sailfish catch rate (fish/1000 longline hooks) for several coastal index areas and spearfish catch rate for central North and South Pacific index areas, where it could be safely assumed that the logbook statistics represented only one of the species, suggested that the some sailfish stocks have undergone considerable reduction whereas spearfish stocks appear relatively stable. These trends in indices of relative abundance suggest that sailfish may be over-harvested while

shortbill spearfish may be under-harvested. Lastly, the generalized production model assessment of swordfish indicates that the fishery is operating close to the estimated MSY level of approximately 19,000 t (Fig. 34C). The statistics include three distinct phases of this fishery: a night longline fishery directed at relatively small fish, a transition phase when day longline fishing directed at larger fish came into being and total fishing effort declined, and a third phase when the day longline fishery expanded.

2. Pelagic Ichthyoplankton Survey

The Honolulu Laboratory's Pelagic FMP Research Program completed the third and final survey to collect early life-history stages of PMUS to resolve fine-scale distributional patterns relative to onshore-offshore island effects, current flow, and other physical features. The three cruises were conducted off leeward Oahu in October-November 1987, off leeward and windward Oahu in May 1988, and in September 1988 off Kona, Hawaii as well as leeward and windward Oahu. Day and night neuston tows were taken with a Manta net on all cruises and with a neuston trawl during the first cruise. Epipelagic waters were sampled with an Isaacs-Kidd midwater trawl during all cruises; on the first cruise separate tows were taken at 50m, 25m, and just below the surface while on the last two cruises stepped oblique tows from a depth of 50m were taken. During all of the cruises, oceanographic observations were made using sampling grids overlaying the areas of biological sampling; data collected included temperature by depth (XBT casts), salinity and temperature by depth (CTD casts), surface temperature and salinity measurements (continuous with a thermosalinograph and by bucket samples taken at XBT and CTD sample sites), and current profiles taken with the acoustic doppler current profiler.

Detailed analyses of the samples are being conducted by Fishery Biologists Robert A. Skillman and James H. Uchiyama to determine the relationship between the distribution of species occurrence and various oceanographic features. Also, species size distribution, age and growth of PMUS larvae, and other biological parameters will be investigated. Ichthyoplankton samples from the first two cruises have been sorted and pelagic species identified. Likewise, salinity samples from the first two cruises have been processed, and preliminary plots of oceanographic features derived from the XBT and surface measurements have been plotted along with the occurrence of PMUS larvae.

3. Billfish Vital Rates Reviewed

In a paper to be published next year in the Proceedings of the Second International Billfish Symposium, Fishery Biologist Christofer H. Boggs reviews the research on billfish age, growth, and mortality and discusses the application of vital rate statistics in stock assessment. The review notes that age-structured stock assessments of billfish are relatively recent developments. In fact, only two age-structured billfish assessments have been made, one for the western Atlantic stock of swordfish and one for Atlantic sailfish, Istiophorus albicans. The availability of adequate size-frequency data and growth models has been a limiting factor in completing age-structured billfish assessments. However, much work on growth rates has been accomplished recently.

The implications of new growth models based on hard parts have not been fully examined, but hard part studies suggest much older ages than do earlier studies, based on analysis of length-frequency modes and growth of recaptured fish (Figs. 35 and 36). The emerging picture is one of rapid growth during the first few years of life, followed by an extended lifespan after maturity, with very slow growth among older fish. Otolith ageing studies suggest that 15-year-old Indo-Pacific blue marlin and 30-year-old swordfish may not be unusual.

The review points out that the discrepancies between different methods of estimating billfish age and growth are so large that mortality estimates based on the wrong model could be biased by >100%. This level of accuracy is inadequate for meaningful stock assessment. Slower growth and lower mortality rate estimates suggested by hard part ageing studies indicate a slower turnover rate. This turnover rate is crucial in determining the amount of fishing the stock can sustain.

Age-structured stock assessment efforts have avoided using recent hard part growth estimates because of an absence of validation studies and frequent lack of verification in comparisons between hard part structures. At the Billfish Symposium (held 1-5 August 1988 in Kailua-Kona on the Island of Hawaii), several papers describing the age/growth verification problem were presented. New techniques of verification indicate consistency between hard part structures, but validation remains extremely difficult for billfish. Increased attention to billfish tagging studies, resulting from the increased participation of sportfishermen, could help resolve discrepancies between growth estimates. Techniques should be promoted to improve size estimation at tagging and to administer hard part marking chemicals to validate growth rate estimates. In his paper, Boggs concludes that it would not be wise to wait for hard part age validation before examining the implications of slow growth and extended lifespan on the status of billfish stocks.

4. Tracking of Marlin Carrying Sonic Tags

Last summer's effort to catch and track Indo-Pacific blue marlin was part of an on-going project being conducted by Kim Holland (Hawaii Institute of Marine Biology) and Richard W. Brill (Honolulu Laboratory). The objectives of the project are to use depth sensitive ultrasonic transmitters to determine the short term vertical and horizontal movements of commercially important pelagic species (e.g. yellowfin, bigeye and skipjack tunas, mahimahi, and marlin) associated with fish aggregating devices (FADs). The project is currently supported by the Honolulu Laboratory, the University of Hawaii Sea Grant Program, HDAR State of Hawaii and Pacific Fisheries Development Foundation (PFDF). Thanks to the efforts of David Grobecker (Pacific Gamefish Research Foundation), who helped secure the necessary additional funding from the NOAA Fisheries Southwest Region, the tracking project was expanded last summer to include Indo-Pacific blue marlin.

Due to the encouragement and offers of help from the anglers, officials, and charter boats involved with the Hawaiian International Billfish Tournament (HIBT), efforts to catch and track Indo-Pacific blue marlin were centered around this annual billfish tournament held in Kailua-Kona, Hawaii. In

the relatively short time available for the project, three Pacific blue marlin were caught, had transmitters attached and were followed for up to 43 hours. The first two marlin followed were captured by tournament participants and the third by the tracking boat itself. Because hooking and successfully subduing a blue marlin is a relatively rare event, without the cooperation of tournament participants and officials, the success enjoyed last summer would not have occurred. Thanks to the many boats willing to capture and then release a marlin after attaching a transmitter, the effective fishing effort was many times greater than it would have been if the tracking boat was forced to fish solely on its own. Working with the HIBT had the additional benefit of generating a large amount of positive press coverage for the tracking project (and for the NOAA Fisheries, Sea Grant, Pacific Gamefish Research Foundation and the University of Hawaii), thanks to the large international press corps in Kailua-Kona to cover the HIBT, many of whom took a keen interest in the marlin tracking project.

The first marlin tracked was an approximately 75 kg (presumably male) animal. It was caught on "the grounds", a popular marlin fishing area about 2 n. miles offshore of the Kailua-Kona airport. This area includes the 50 fathom reef drop-off (Fig. 37). After release (at approximately 11 AM), the fish swam almost straight west for the next 17 hours. After reaching a point approximately 17 miles offshore, it swam north for the next 8 hours, after which contact was lost due to very rough seas. The second marlin tracked was approximately the same size and was captured in the same area. It also swam directly west for the first 12 hours following release and then turned south. It proceeded south for the next 23 hours, and then moved toward the shoreline during the last 8 hours. The track was abandoned after 43 hours because of crew fatigue. The third marlin tracked was caught by the tracking vessel. It was the largest fish tracked, weighing approximately 175 kg. It was caught in the same area as the first two fish and also proceeded directly offshore for the first 8 hours after release. It then turned and swam on a southeasterly course, eventually reaching a point approximately two miles offshore 23 hours later. The fish was followed for an additional 5 hours, when the track was finally terminated due to badly deteriorating sea conditions near the southern tip of the island.

With respect to depth of swimming, all three marlin spent the vast majority of their time in the mixed layer (i.e. shallower then approximately 130 meters, see Fig. 38). All of the fish made frequent excursions to the surface, with the largest fish repeatedly spending several consecutive hours at the surface.

These data clearly show, among other things, that Indo-Pacific blue marlin survive after capture and release. The largest marlin tracked was fought for over 30 minutes and appeared completely exhausted when finally brought along side the boat. However, it also appeared to quickly recover. Holland and Brill hope to get several additional marlin tracks next summer during the HIBT. They then plan to publish the data in a scientific journal as soon as possible after that.

II. Waikiki Aquarium Finfish Aquaculture Program

1. Mass Culture Methods for the Mahimahi, Coryphaena hippurus.

From June of 1987 through May of 1988, Syd Kraul of the Waikiki Aquarium has carried out research to develop mass culture methods for mahimahi. The project is part of a cooperative State and Federal effort to develop methods for rearing thousands of juvenile mahimahi. The work at the Aquarium included: a) maintaining broodstock and rearing successive inbred lines; b) rearing larvae to test quality of inbred eggs versus wild eggs, as measured by comparing survival through metamorphosis; c) rearing larvae in 4,000 liter tanks to compare weaning foods and methods, and also for larval growth and survival at different stocking densities; d) rear larvae in large tanks (30,000 l) to confirm methods for expanded scale culture; e) investigate genetic tags as a method to assess the potential for releasing small fish and larvae.

The following results were achieved for the goals listed above:

a. The Aquarium was able to maintain third (F3) and fourth (F4) generation broodstock and produce enough eggs and larvae to transfer them to other research centers. F3 females produced eggs dependably for 7 months until the last adult female died in early February 1988. F4 larvae and fingerlings were transferred to a number of institutions including the State of Hawaii's Anuenue Fisheries Research Center (AFRC) for tagging and grow out trials, and to Oceanic Institute (OI) for rearing tests. Broodstock safety has continually improved and in early June of 1988, AFRC and the Aquarium had more than 60 adults in 4 tanks; OI had 28 subadults; MCE had 5 subadults; and QLCC had 8 subadults.

b. Although tests will continue on the growth, survival, and morphology when wild-eggs are available, the tests conducted in 1987 did not detect any significant difference in size or survival for F4 versus wild larvae at 5 days post-hatch.

c. Initially weaning trials were deferred pending the identification and development of a suitable live diet to carry mahimahi through days 20 to 30. The dependability of the broodstock permitted feeding newly hatched mahi to older fry (18-45 days). Based on these and other trials the optimum diet presently recommended is: rotifers, day 2-8; copepods, day 6-25; mahi hatchlings, day 18-45; chopped squid after day 30. Toward the end of 1988, research will shift to focus on testing diets of non-living foods for postlarvae.

One of the outcomes of the large tank rearing trials was that larval mortality which was hypothesized to result from bacterial proliferation and feeding physiology may be more closely linked to stocking density. Larvae stocked .18 per liter had 28% survival through day 30. Larvae stocked 3 per liter had 22% survival to day 25, after which the high numbers of surviving individuals (2715 fry; l=43 mm, wt=115 g) dwindled rapidly as the result of an epizootic disease outbreak. Larvae stocked at 1 per liter (4000 l tank) attained 20% survival at day 30 and 10% at day 60 (industry standards average 1%). The methodology of this trial is well documented and will be used as a reference to compare mortality from future trials which will compare different foods and

bacterial controls.

d. Some expanded scale trials were conducted in 200 m^2 tanks, and further tests are planned.

e. Dr. Rebecca Cann and Chris Herzig from the University of Hawaii's genetic department have sampled mitochondrial DNA and attempted to detect variations that could serve as genetic tags to facilitate assessment of stock enhancement efforts and their effects.

Sid Kraul and Jim Szyper are also co-authoring a chapter on hatchery methods for the mahimahi, Coryphaena hippurus, at the Waikiki Aquarium, which is the culmination of 5 years of research, which will be included in an upcoming CRC Handbook on marine fish culture.

III. Oceanic Institute

1. Mahimahi Activity at the Oceanic Institute: 1987-1988

Mahimahi have been kept intermittently at the Oceanic Institute since 1979, when they were first taken through a complete generation in captivity. During 1986-1987, several sub-adult mahimahi captured at sea were acquired by the Institute and held to maturity. Eggs for about a dozen rearing trials were obtained from these fish. Eggs were also obtained from broodstock reared by Syd Kraul of the Waikiki Aquarium.

Research emphasis has been on the larval stage, in particular, rearing methods and larva nutrition.

It has long been known that survival of larvae is poor on Artemia alone, but that mortality can be reduced by the addition of cultured copepods to the diet. Enrichment of Artemia with essential fatty acids prior to feeding obviates the need for live copepods.

Biochemical analyses (amino acid and fatty acid composition) of larvae and juveniles at various ages were conducted, and these data gave us some indication of dietary requirements of these stages.

Several alternative cultured live foods were tested on mahimahi larvae: the calanoid copepods, Paracalanus and Pseudodiaotomus. and the cladoceran, Diaphanosoma. Larvae do very well on copepods, but the relative ease of supplying Artemia makes the latter a more useful live food.

Artemia are now mass-cultured at the Institute to provide appropriately sized live food for mahimahi larvae.

Several groups of reared juvenile fish contracted marine ick (Cryptocaryon, ciliated protozoan parasite), which is generally acutely lethal in this species. An effective treatment was found.

The primary objective of mahimahi research at the Oceanic Institute has

been to solve problems in the mass-culture of this species, whether for aquaculture purposes or for enhancement of natural stocks.

IV. State of Hawaii

1. Mahimahi Rearing and Feeding Experiments

Although the primary function of the Anuenue Fisheries Research Center of HDAR is to maintain mahimahi broodstock, it has been rearing mahimahi and conducting feeding experiments. Experiments with 26-day old juveniles fed diets (over 26 days) which consisted in part of beef liver showed significantly increased survival and growth over cohorts fed on squid and mahimahi hatchlings. Survival increased from 50 to 100 percent through the test period. Fork lengths of mahi fed in part on beef liver were on average 1.6 times longer (19.88 cm versus 12.22 cm) and weighed 6.5 times as much (88.23 gm versus 13.14 gm).

2. Mahimahi Tag and Release Project

As of August 25, 1988, 66 mahi, ranging in fork length from 23.5 - 61.6 cm and wet weight from 0.16 - 1.93 kg, were tagged and released on trial bases. Flyers have been posted to alert fishermen and instruct them on returning the tags. Tagging studies can assist in determining migratory patterns and assessing stock enhancement efforts.

V. Pacific Gamefish Research Foundation

1. "Burnt Tuna" -- Finding the Cause: A First Step Towards Solving the Problem

Continuing research to establish the cause of "burnt tuna" is currently being conducted by the Pacific Gamefish Research Foundation under funding provided by the State of Hawaii and the NMFS under the guidance of Dr. Richard Brill, Scientific Advisory Committee member and leader of the Tuna Behavior and Physiology Program, National Marine Fisheries Service, Honolulu.

A solid casual link between high muscle temperatures and acidity and the phenomenon of "burnt tuna" has never been conclusively demonstrated, although other investigative work to date has been based on this assumption. Consequently, recommendations to mitigate this problem have focused on various attempts to capture and cool the fish quickly. Reliable cost effective methods to accomplish this are often difficult to devise for small fishing vessels that are out at sea for extended periods of time.

Recent discoveries by Dr. Peter Hochachka of the Department of Zoology, University of British Columbia, indicate that high calcium levels within the muscle cells might be causing the activation of destructive enzymes. These enzymes literally digest certain components of the muscles, giving the fish its unpalatable appearance, texture, and taste.

The objective of the research being conducted by the Pacific Gamefish

Research Foundation is to test Dr. Hochachka's hypothesis and also to test chemical solutions that can be easily used by fishermen to reduce this destructive enzyme activity and control or eliminate the problem.

A loss of more than a million dollars a year on a worldwide basis can be attributed to "burnt tuna" by troll fishermen who sell their tuna for food. In Hawaii alone, the problem costs the commercial handline tuna fishing industry more than $400,000 annually. This does not take into account the effects on the wholesale, retail, and food service industries, and on the consumer. Finding the cause and working out a solution to this problem is a top priority of the Pacific Gamefish Research Foundation along with PGRF affiliate scientist, Dr. Richard Brill.

2. Analyzing the Predatory Feeding Behavior of Marlin

Recent advances in underwater video techniques allow scientists to accurately record the feeding behavior of marlin for the first time. These fish are highly advanced predators, but very little is known about how they subdue and engulf their prey and how they use their bills in the process.

The Pacific Gamefish Research Foundation has access to the technology and resources needed to conduct a significant investigation of the feeding process, which will benefit both the scientific and fishing communities. A careful study of the bones, muscles, and ligaments of the marlin's head and pectoral girdle are being made and then superimposed over a detailed analysis of video tapes of live feeding activity.

Results of this study will be published in professional journals and magazines and recorded on a promotional videotape, which will be an informative resource for both recreational and commercial fishermen. These studies and their visual documentation are expected to give both scientists and policy makers information on conditions essential for marlin to feed, thrive, and mature, thereby assisting the management of the species.

3. Locating and Analyzing Marlin Spawning Grounds

In order to protect the future of all Pacific gamefish, including the Pacific blue marlin, PGRF scientists are locating their spawning grounds. This vital information requires the compilation and analysis of years of data from a variety of sources.

The Pacific Gamefish Research Foundation has been coordinating continuing efforts among scientists, anglers, and government agencies to chart spawning locations. Research by Foundation affiliate scientist, Dr. Carol Hopper, has revealed that Pacific blue marlin are in spawning condition off the Kona Coast during the summer months. This information, combined with data on capture location and spawning condition of each fish collected by PGRF scientists during Kona fishing tournaments, is correlated to determine where the probable spawning areas are.

Infra-red satellite photos showing water temperatures and eddies that

will define the oceanographic conditions in these localities are being sought from the National Oceanic and Atmospheric Administration (NOAA). Small aircraft will also be chartered to photograph areas where greater detail is needed. These photos will help scientists determine the environmental conditions necessary for survival in the early life of these fish. This information is essential to ensure the preservation and abundance of adults of the species.

4. Promotion and Support of Tag and Release

"Tag and Release" is a national program sponsored by the U.S. Department of Commerce, National Oceanic Atmospheric Administration, National Marine Fisheries Service. The Pacific Region is administered by the Southwest Fisheries Center in La Jolla, California. The purpose of this program is to collect information on the migration and growth of gamefish to ensure preservation of the species.

The Pacific Gamefish Research Foundation is an active participant in this program and a promoter of "tag and release" at fishing tournaments throughout the State and the Pacific Basin.

A yellow tag or streamer mounted on a plastic or stainless steel barb and coded with a number is inserted into the back of a fish by means of a pole fitted with a metal applicator tip. This process takes place immediately after the fish has been reeled in and is being held in the water alongside the boat. The fishing line is then cut close to the hook, and the fish is released. The hook will rust and fall out in time. Meanwhile, it does not interfere with the feeding ability of the fish.

A tagging card with the same number as the tag is filled out with the date, location, species, estimated weight and length, remarks, and the angler's name and address. This report is then mailed to the National Marine Fisheries Service, where the information is recorded and retained for comparison data if the fish is caught again.

Reduction and depletion in many fish populations on a worldwide basis indicates a growing need to eliminate the unnecessary killing of these fish. Anglers are urged to tag and release a catch unless it might be a record, is the first marlin the angler has ever caught, or is a fish that is to be mounted.

Tagging and releasing a fish places emphasis on the angler's skill and the sport of gamefishing, while conserving these valuable fish. The yellow tag is tangible proof of the catch. It also gives the fish an identity and a recorded history while recycling it for later catch by another fisherman.

With funding from the Western Pacific Regional Fishery Management Council, the Pacific Gamefish Research Foundation has produced a videotape titled Marlin Conservation: Tag and Release to be used as an educational and promotional resource on a national and worldwide basis. This tape includes information on different tags and how to insert them as well as special underwater shots of fish swimming away after the tagging process.

5. Age and Growth Studies of the Pacific Blue Marlin

The continued viability of billfish stocks is of substantial importance to sport and commercial fishermen alike. Their high value in the marketplace and economic significance to many sportfishing communities have made billfish one of the most valuable oceanic fish. However, increased effort, improvement of commercial fishing techniques, and expansion of fishing grounds since the mid-1950's have raised concern about the strength of Pacific billfish stocks. Current trends in catch data from the Japanese longline fishery have lead to the conclusion that Pacific blue marlin stocks have been "substantially" overfished. In order to formulate basic management policies and maintain billfish stocks at a level which would provide the greatest overall benefit to sport and commercial fisheries, it is necessary for scientists to close a major gap in our present knowledge of billfish biology, behavior, and ecology. Information on their population age structure, growth rates, and lifespans will enable use to develop population dynamics models and predict the future condition billfish populations.

The most reliable means of estimating age and growth rates of fishes is by examination of calcified hard parts for growth patterns, and by tag and recapture studies for validation of these age estimates. Some of these ageing structures include otoliths (ear bones), vertebrae, fin spines and ocular bones. It is important to examine as many of these structures as possible since the degree of usefulness of each will vary for each fish species. The purpose of the research was to examine, interpret, and compare growth patterns found in the otoliths, vertebrae, and dorsal and anal fin spines of blue marlin (Makaira nigricans), and to provide some information on their growth rates.

With the support of the California Sea Grant College Program and the full cooperation of the Pacific Gamefish Research Foundation, it has been possible to collect a variety of hardpart samples from blue marlin during the summer HIBA tournaments of 1982, 1983, and 1984. To date, otoliths, vertebrae and fin spines from a total of 213 male and 106 female blue marlin have been collected. Males ranged in size from 42 to 306 lbs., and females ranged from 46 to 1,649 lbs.

In a previous article to the Pacific Gamefish Research News (Vol. 3, No. 2, 1984), we described some of the techniques used to examine these various structures have been described, as well as some of the problems associated with ageing marlin.

6. Meeting Critical Information Needs

This paper, to be published in the Proceedings of the Second International Billfish Symposium, is a synthesis and integration of ideas taken from the Billfish Symposium panel which dealt with the biological and statistical requirements for management most needed in order to enhance the ability to understand and manage billfishes. The panels topics included stock identification, vital statistics, strategies for management modeling and socio-economic needs.

Priority objectives included the following:

o Produce a complete and consistent taxonomy for billfish;

- o Achieve a better understanding of billfish spawning and early life history, including the role of environmental factors in reproduction and abundance;

- o Improve knowledge of ageing and growth in billfish;

- o Collect socio-economic information on the commercial, recreational and artisanal fisheries for billfish;

- o Encourage, stimulate and support young biologists interested in billfish work;

- o Identify distinct stocks and their distribution;

- o Investigate and promote ways to reduce the incidental catch of billfish in tuna and other fisheries;

- o Study and evaluate the food chain, focusing on forage species;

- o Improve population models (used in stock assessments) to fit the available data;

- o Encourage the recent trend among recreational fishermen toward releasing marlin and sailfish alive, and the tagging of released fish to assist studies in stock identification and distribution.

The paper is authored by Dr. David B. Grobecker, Scientific Director, Pacific Gamefish Research Foundation.

7. Biological Profile of Juvenile Billfishes

Recent discoveries of juvenile shortbill spearfish off the Kona Cost of Hawaii has provided before unknown information concerning this species' early life history.

a. Growth Rates

Recent work has provided considerable clues to the ages of billfish. These studies are based on examination of bony parts for banding patterns, either annual, or even daily. Very small fish (under say 10 kg) are needed to help in validating the periodicity of such bands, since they would almost certainly be less than one year old at that size.

b. Identification

A range of sizes, from very young through to adult is important for obtaining proportional measures of body parts. And, more constant characters must be found to identify juveniles.

c. Nursery Areas

The recording of the locations of capture of very young billfish could eventually result in the designation of "nursery" areas, with implications for future conservation and management.

d. Early Dispersal

Some spawning grounds of billfish are now reasonably well known; (e.g., Hawaii and the Great Barrier Reef). During the first few months of life, when they are feeding and growing rapidly, (to several kg in a matter of a few months), the location of small billfish, progressively increasing in size, can provide clues to rates of dispersal from spawning areas.

e. Diet

Feeding ecology of small billfishes is also of considerable interest. Do they eat their own kind, and do they pick small individual food items from the water column as do their parents?

f. Parasites

Determining at what stage in their life cycle billfishes are infected by internal and external parasites can greatly assist comparative population studies based on differences in parasitic infestation rates.

Any billfish under about 10 kg, especially the marlins, is of importance to the above studies. Experience has shown that any such specimen is most uncommon, and all efforts should be made to retain these.

8. Food Habits of the Pacific Blue Marlin

Research results published in Pacific Gamefish Research News, Vol. 6, No. 1, 1987 by PGRF affiliate scientists Dr. Richard Brock, is shown in part in Tables 6-8.

PROBLEMS REQUIRING COUNCIL CONSIDERATION AND ACTION

At this time the Team does not believe there are any pressing problems regarding the status of PMUS resources in the western Pacific, but the Team is concerned about the quality and availability of certain statistics necessary to properly monitor and manage the resources.

First, there is a general lack of biological information on the PMUS including estimates of various vital parameters and how these vary among the fisheries. Likewise, a region-wide coordinated plan for the collection of biological samples and data on size composition does not presently exist. However, the NMFS has provided additional resources to begin working on size-composition data. Continued Council endorsement of such research and commitment of programmatic funds for expanding supportive data collection activities, particularly in American Samoa, Guam, and Northern Mariana Islands is essential if progress is to be made in a timely fashion.

Second, the failure of domestic tuna longline vessels in the Hawaii fishery to submit "Fish Catch Reports" to the Department of Land and Natural Resources severely restricts the Team's ability to monitor the status of the fishery for billfishes, particularly for Indo-Pacific blue marlin, striped marlin, and swordfish. The tuna longline fishery has been and remains an important component of the fishery for these species. Without a time series of tuna longline data that is not broken or modified due to lack of reporting, it becomes very difficult to assess the impact of other changes on the resources, such as the cessation of foreign tuna longline fishing in the FCZ surrounding Hawaii.

RECOMMENDED ACTIONS

The Team did not vote for any specific recommendations, except those regarding programmatic funds. These recommendations were forwarded to Council staff and appear in the minutes of the 31 October Team meeting.

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Hamm, David C. and Todd T. Kassman. 1986. Fishery statistics of the western Pacific, Volume I. American Samoa (1982-84), Commonwealth of the Northern Mariana Islands (1979-84), State of Hawaii (1979-84). NMFS, SWFC Administrative Rep. H-86-4, pag. var.

Hamm, David C. and Michael M.C. Quach. 1988. Fishery statistics of the western Pacific, Volume III. Territory of American Samoa (1985-86), Commonwealth of the Northern Mariana Islands (1985-86), Territory of Guam (1985-86), State of Hawaii (1985-86). NMFS, SWFC Administrative Rep. H-88-4, pag. var.

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FIGURES

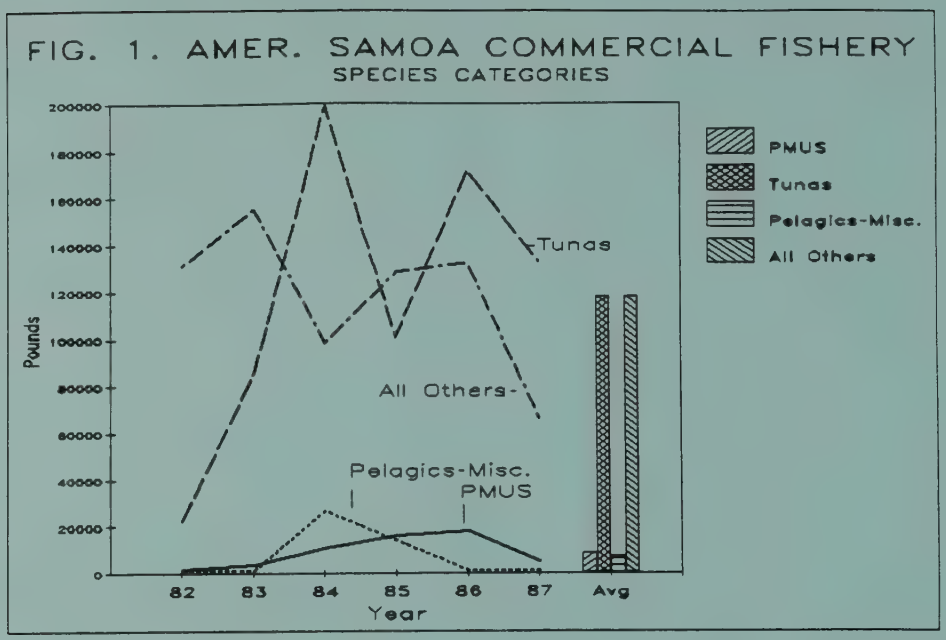


FIG. 1. AMER. SAMOA COMMERCIAL FISHERY
SPECIES CATEGORIES
Pounds
200000
180000
160000
140000
120000
100000
80000
60000
40000
20000
0
Tunas
All Others
Pelagics-Misc.
PMUS
82
83
84
85
86
87
Avg
Year
PMUS
Tunas
Pelagics-Misc.
All Others

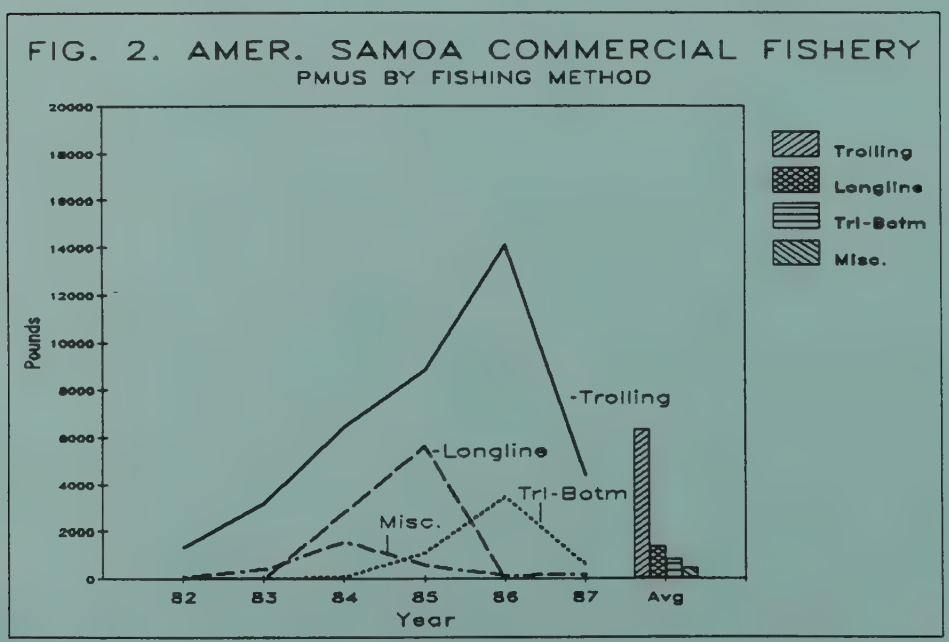


FIG. 2. AMER. SAMOA COMMERCIAL FISHERY
PMUS BY FISHING METHOD
Pounds
20000
18000
16000
14000
12000
10000
8000
6000
4000
2000
0
Trolling
Longline
Tri-Botm
Misc.
82
83
84
85
86
87
Avg
Year
Trolling
Longline
Tri-Botm
Misc.

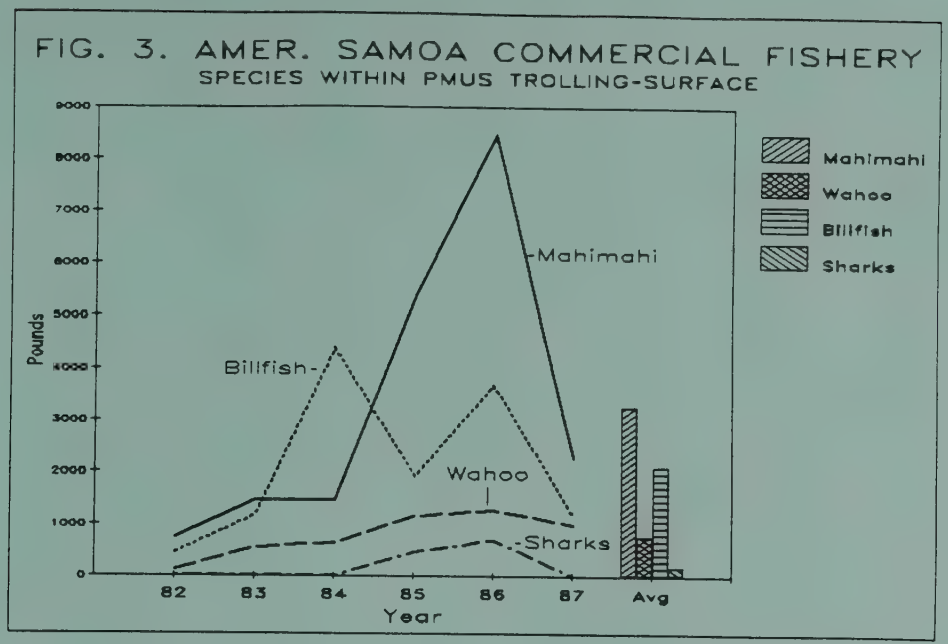


FIG. 3. AMER. SAMOA COMMERCIAL FISHERY
SPECIES WITHIN PMUS TROLLING-SURFACE
Pounds
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
Billfish
Mahimahi
Wahoo
Sharks
82
83
84
85
86
87
Avg
Year
Mahimahi
Wahoo
Billfish
Sharks

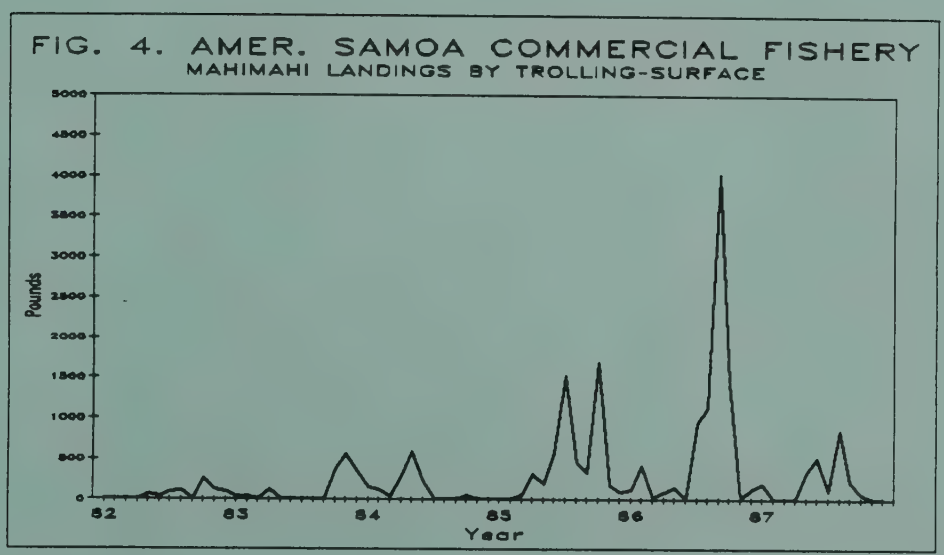


FIG. 4. AMER. SAMOA COMMERCIAL FISHERY
MAHIMAHI LANDINGS BY TROLLING-SURFACE
Pounds
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0
82
83
84
85
86
87
Year

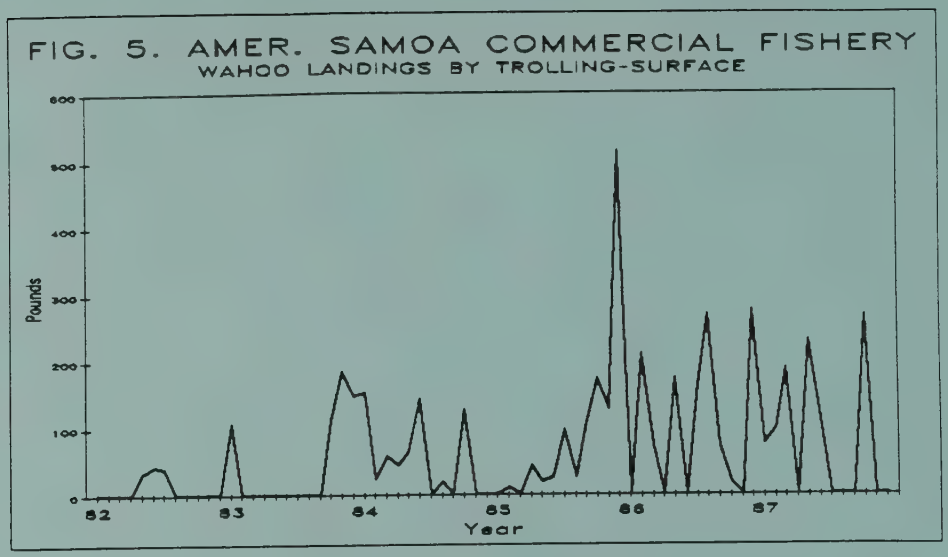


FIG. 5. AMER. SAMOA COMMERCIAL FISHERY
WAHOO LANDINGS BY TROLLING-SURFACE
Pounds
600
500
400
300
200
100
0
82
83
84
85
86
87
Year

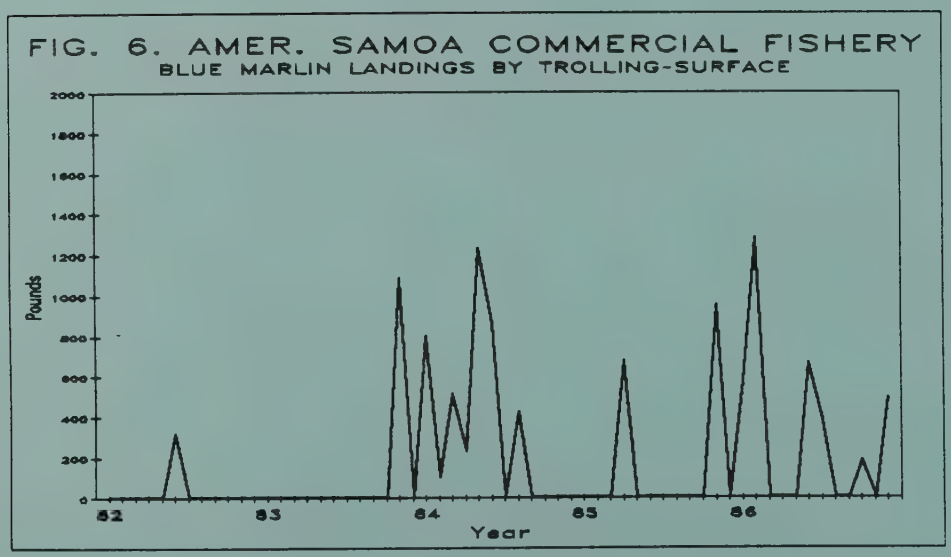


FIG. 6. AMER. SAMOA COMMERCIAL FISHERY
BLUE MARLIN LANDINGS BY TROLLING-SURFACE
Pounds
2000
1800
1600
1400
1200
1000
800
600
400
200
0
82
83
84
85
86
Year

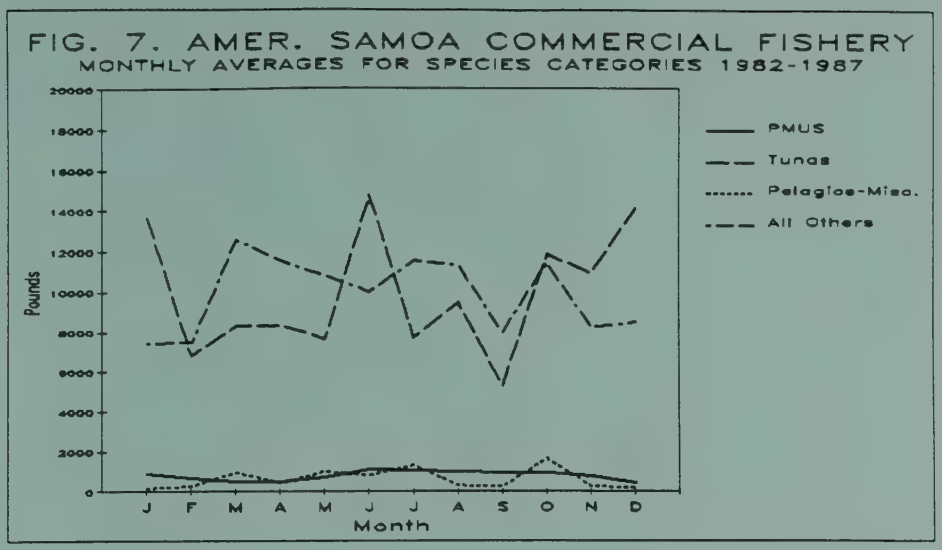


FIG. 7. AMER. SAMOA COMMERCIAL FISHERY
MONTHLY AVERAGES FOR SPECIES CATEGORIES 1982-1987
Pounds
Month
J F M A M J J A S O N D
PMUS
Tunas
Pelagics-Misc.
All Others

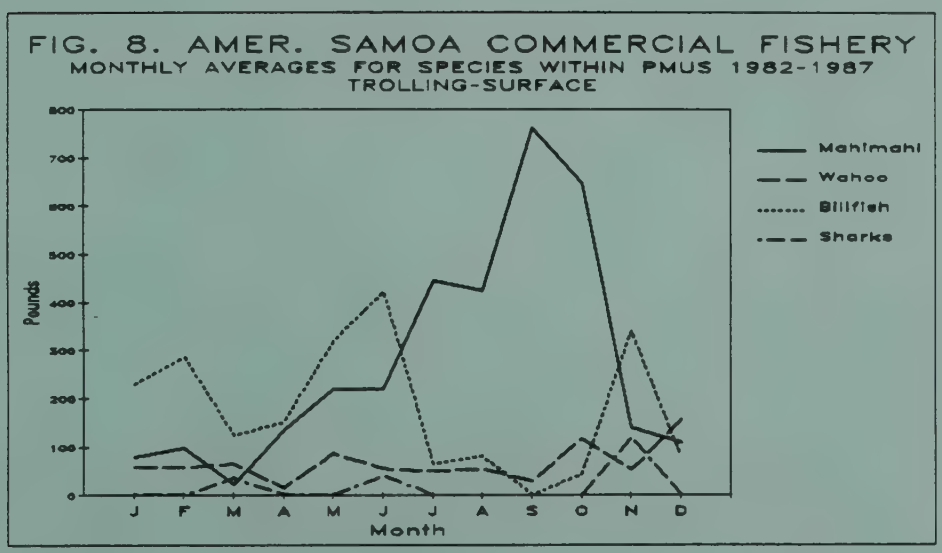


FIG. 8. AMER. SAMOA COMMERCIAL FISHERY
MONTHLY AVERAGES FOR SPECIES WITHIN PMUS 1982-1987
TROLLING-SURFACE
Pounds
Month
J F M A M J J A S O N D
Mahimahi
Wahoo
Billfish
Sharks

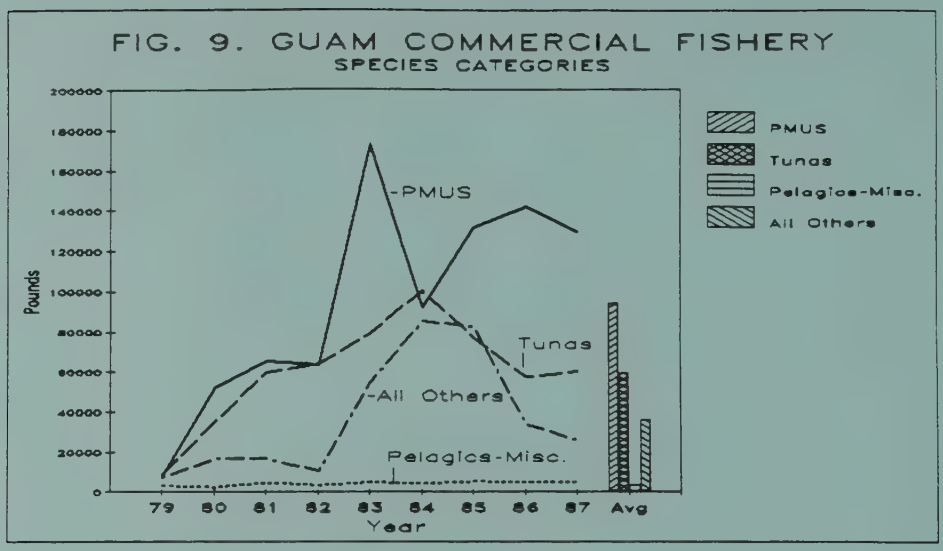


FIG. 9. GUAM COMMERCIAL FISHERY
SPECIES CATEGORIES
Pounds
Year
79 80 81 82 83 84 85 86 87 Avg
PMUS
Tunas
Pelagics-Misc.
All Others
-PMUS
Tunas
-All Others
Pelagics-Misc.

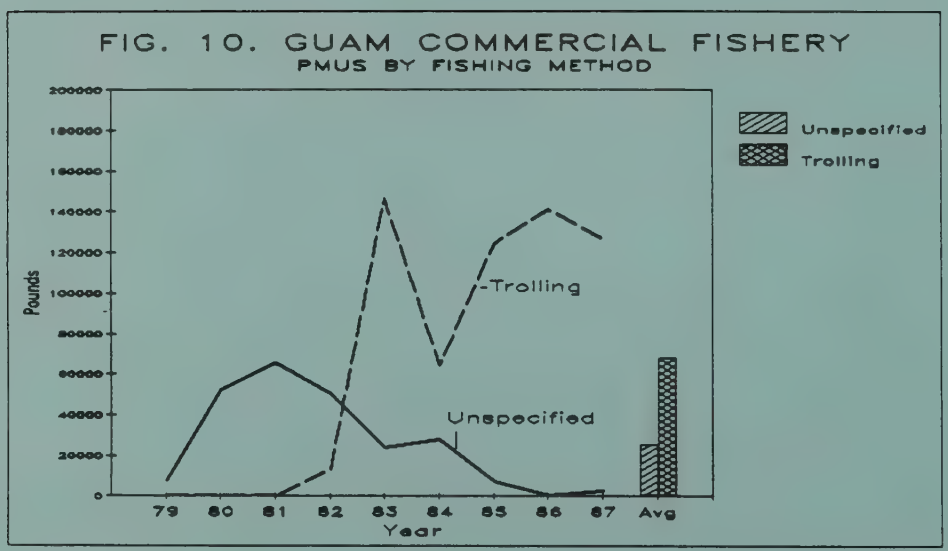


FIG. 10. GUAM COMMERCIAL FISHERY
PMUS BY FISHING METHOD
Pounds
Year
79 80 81 82 83 84 85 86 87 Avg
Unspecified
Trolling
-Trolling
Unspecified

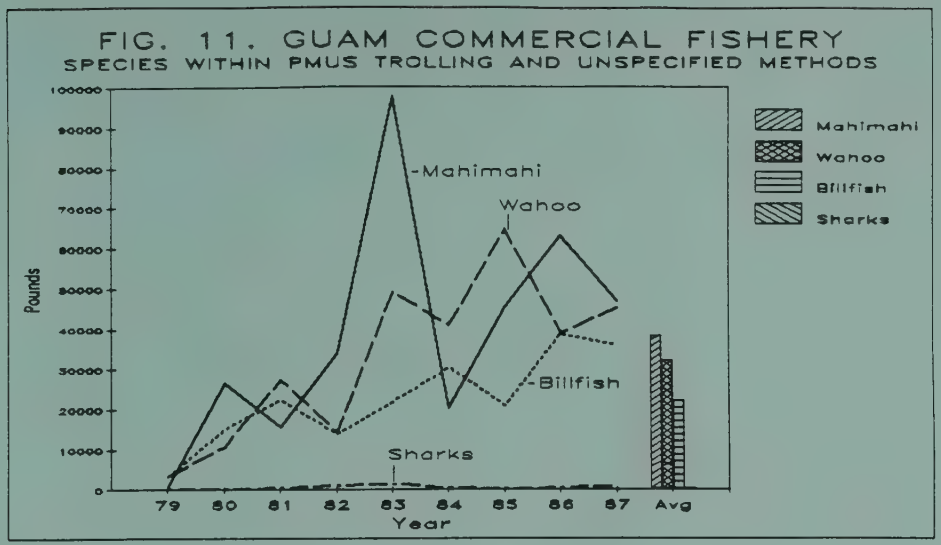


FIG. 11. GUAM COMMERCIAL FISHERY
SPECIES WITHIN PMUS TROLLING AND UNSPECIFIED METHODS
Pounds
Year
Mahimahi
Wahoo
Billfish
Sharks
79
80
81
82
83
84
85
86
87
Avg

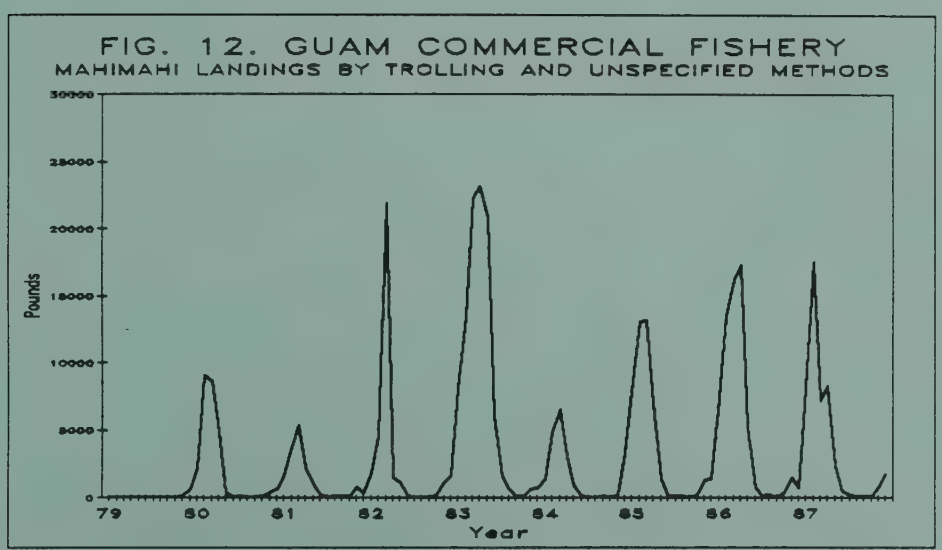


FIG. 12. GUAM COMMERCIAL FISHERY
MAHIMAHI LANDINGS BY TROLLING AND UNSPECIFIED METHODS
Pounds
Year
79
80
81
82
83
84
85
86
87

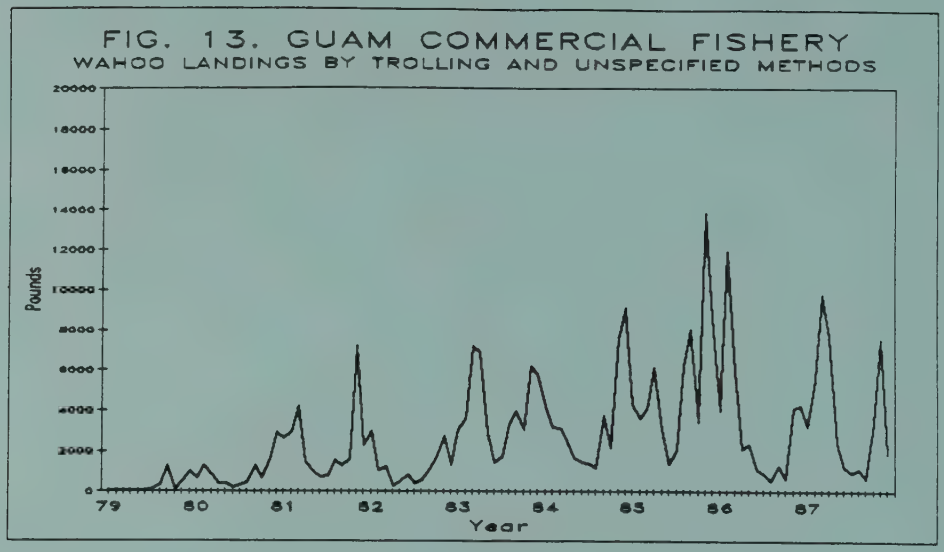


FIG. 13. GUAM COMMERCIAL FISHERY
WAHOO LANDINGS BY TROLLING AND UNSPECIFIED METHODS
Pounds
20000
18000
16000
14000
12000
10000
8000
6000
4000
2000
0
79
80
81
82
83
84
85
86
87
Year

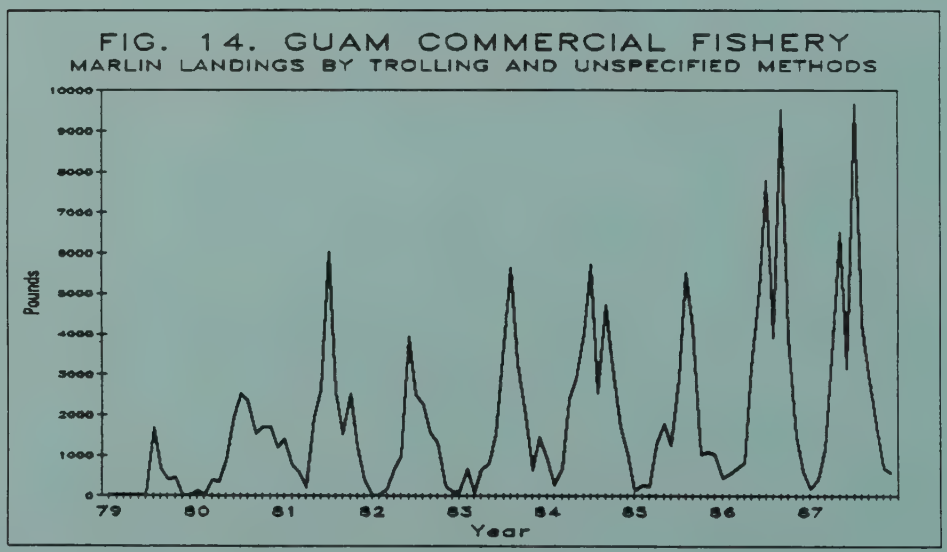


FIG. 14. GUAM COMMERCIAL FISHERY
MARLIN LANDINGS BY TROLLING AND UNSPECIFIED METHODS
Pounds
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
79
80
81
82
83
84
85
86
87
Year

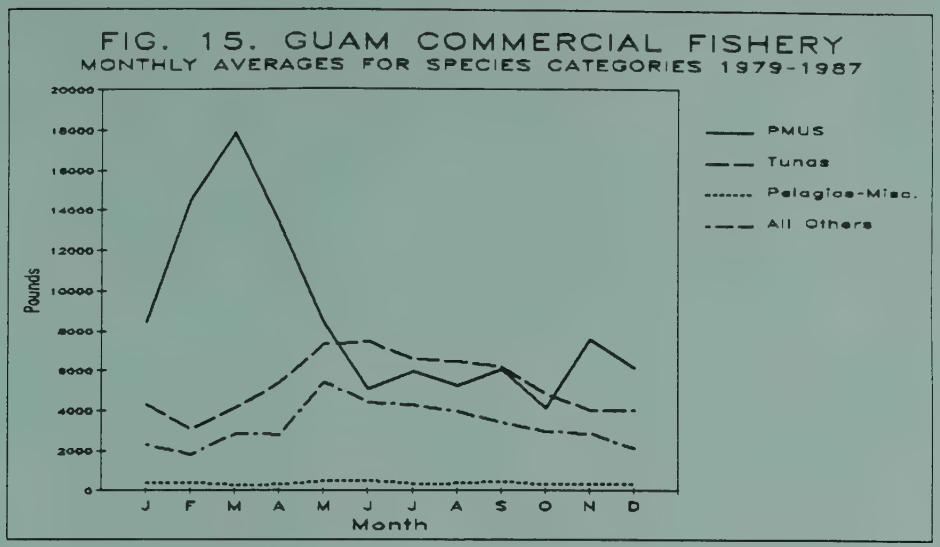


FIG. 15. GUAM COMMERCIAL FISHERY
MONTHLY AVERAGES FOR SPECIES CATEGORIES 1979-1987
Pounds
Month
J F M A M J J A S O N D
PMUS
Tunas
Pelagics-Misc.
All Others

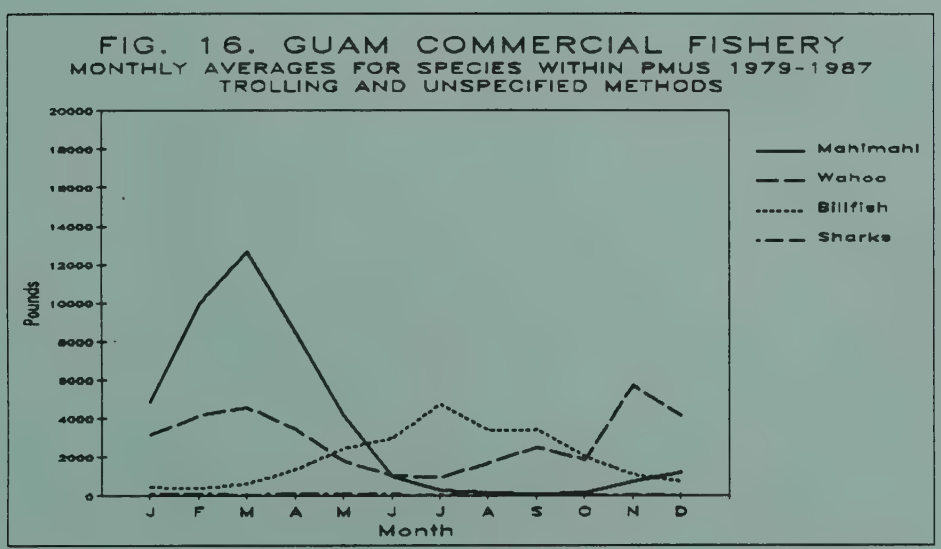


FIG. 16. GUAM COMMERCIAL FISHERY
MONTHLY AVERAGES FOR SPECIES WITHIN PMUS 1979-1987
TROLLING AND UNSPECIFIED METHODS
Pounds
Month
J F M A M J J A S O N D
Mahimahi
Wahoo
Billfish
Sharks

FIG. 17. Hawaii 1979—1986
Annual Trends of
Tunas, PMUS, and BMUS Landings

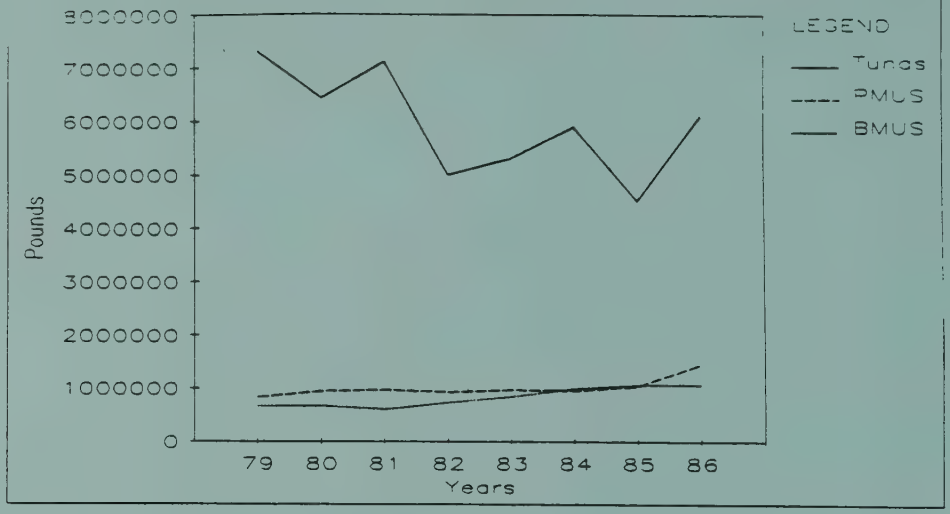
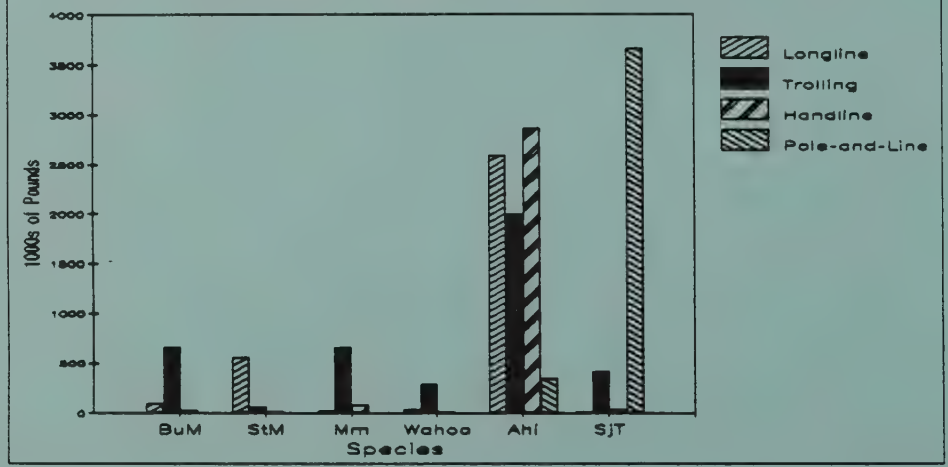


Fig. 18. Hawaii PMUS Landings by Gear
1987 Honolulu Lab. Market Survey Data



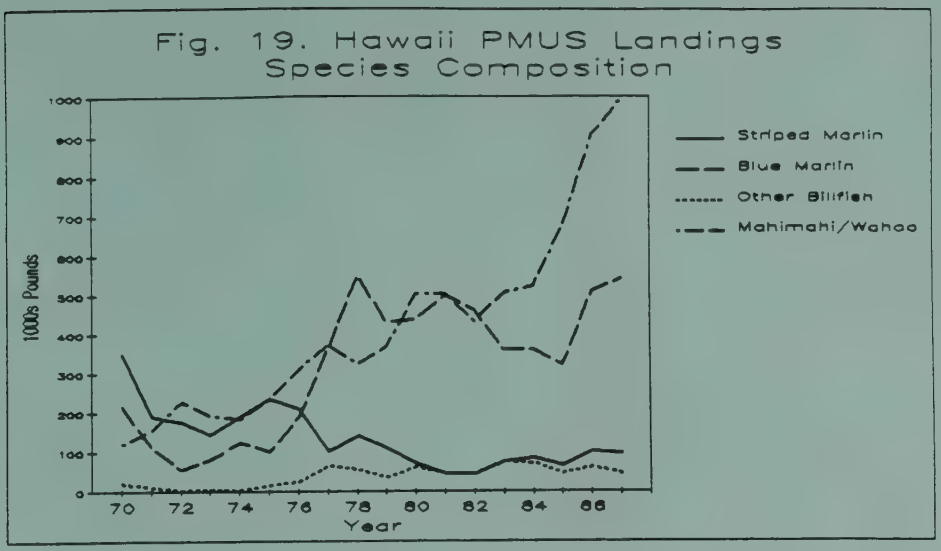


Fig. 19. Hawaii PMUS Landings
Species Composition
1000s Pounds
Year
70 72 74 76 78 80 82 84 86
Striped Marlin
Blue Marlin
Other Billfish
Mahimahi/Wahoo

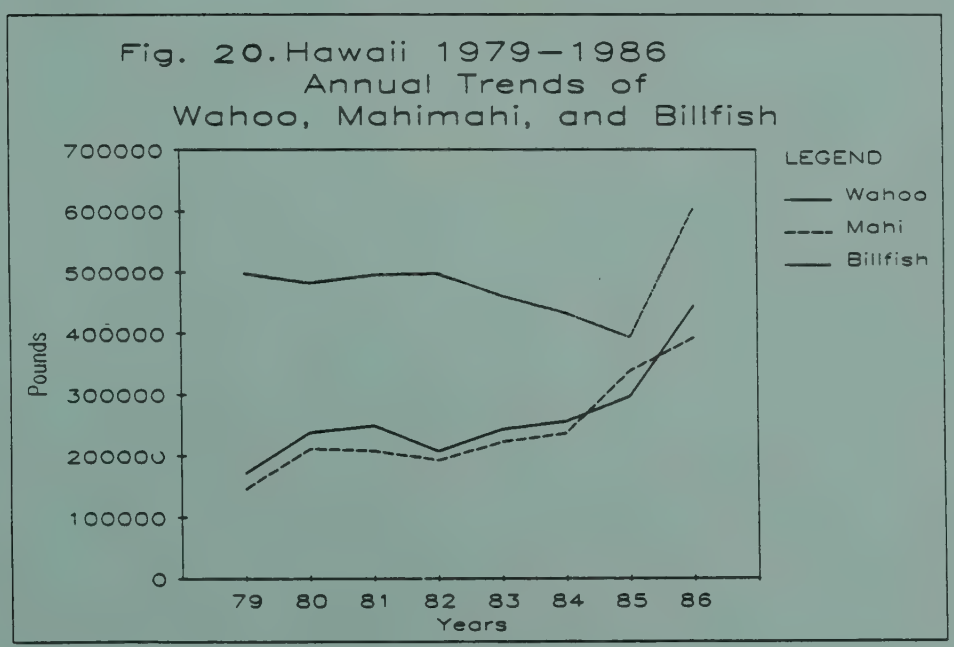


Fig. 20. Hawaii 1979–1986
Annual Trends of
Wahoo, Mahimahi, and Billfish
Pounds
700000
600000
500000
400000
300000
200000
100000
0
79 80 81 82 83 84 85 86
Years
LEGEND
Wahoo
Mahi
Billfish

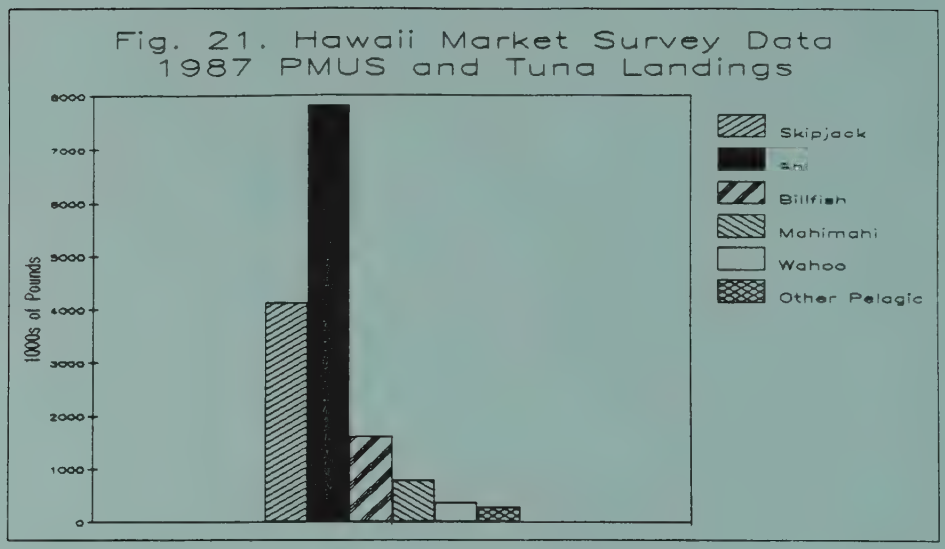


Fig. 21. Hawaii Market Survey Data
1987 PMUS and Tuna Landings
1000s of Pounds
8000
7000
6000
5000
4000
3000
2000
1000
0
Skipjack
Ahi
Billfish
Mahimahi
Wahoo
Other Pelagic

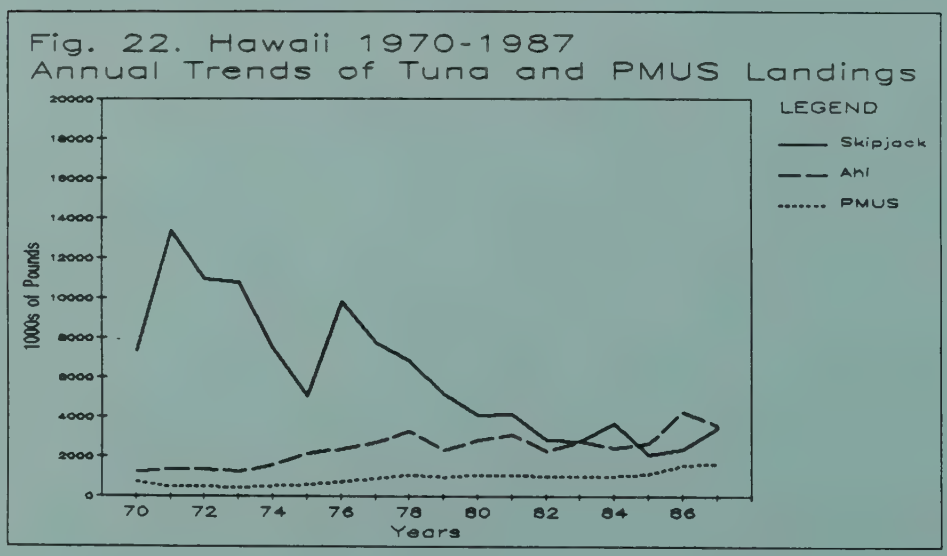


Fig. 22. Hawaii 1970-1987
Annual Trends of Tuna and PMUS Landings
1000s of Pounds
20000
18000
16000
14000
12000
10000
8000
6000
4000
2000
0
70
72
74
76
78
80
82
84
86
Years
LEGEND
Skipjack
Ahi
PMUS

FIG. 23. Hawaii 1979–1986
Average Monthly Landings of
Tunas, PMUS, and BMUS

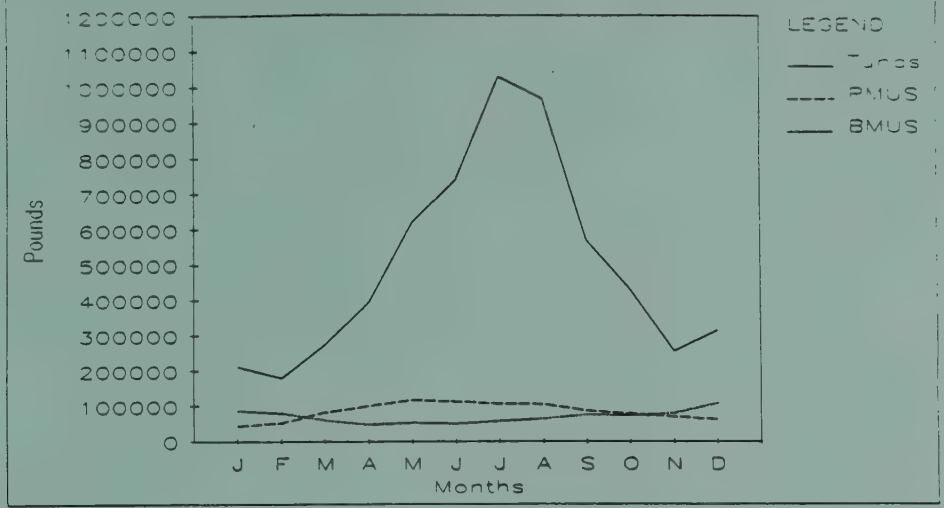


FIG. 24. Hawaii 1979–1986
Average Monthly Landings of
Wahoo and Mahimahi

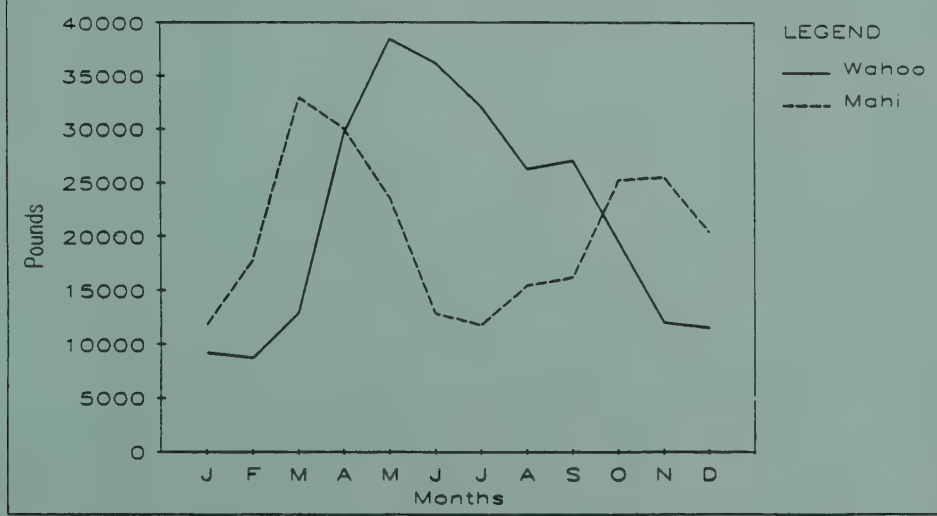


FIG.25. Hawaii 1979—1986
Average Monthly Landings of
Marlin Species

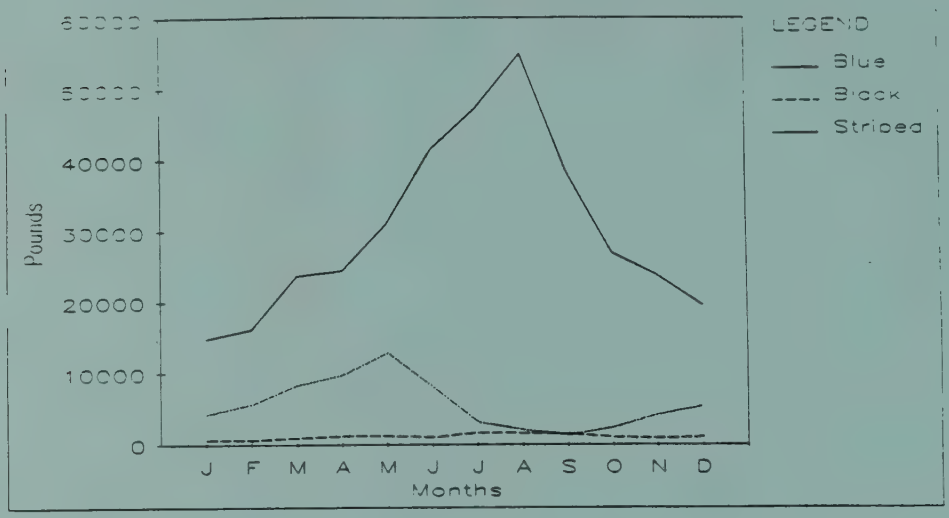
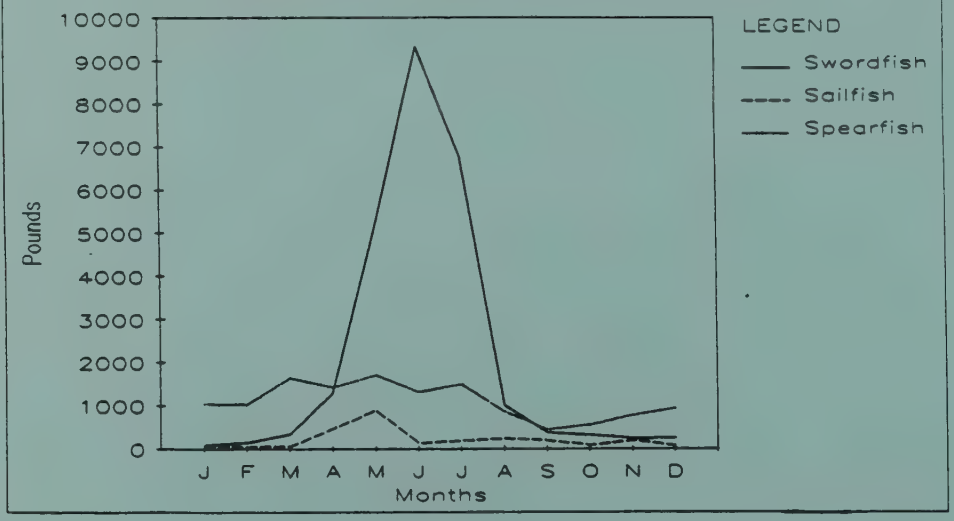


FIG.26. Hawaii 1979—1986
Average Monthly Landings of
Swordfish, Sailfish, and Spearfish



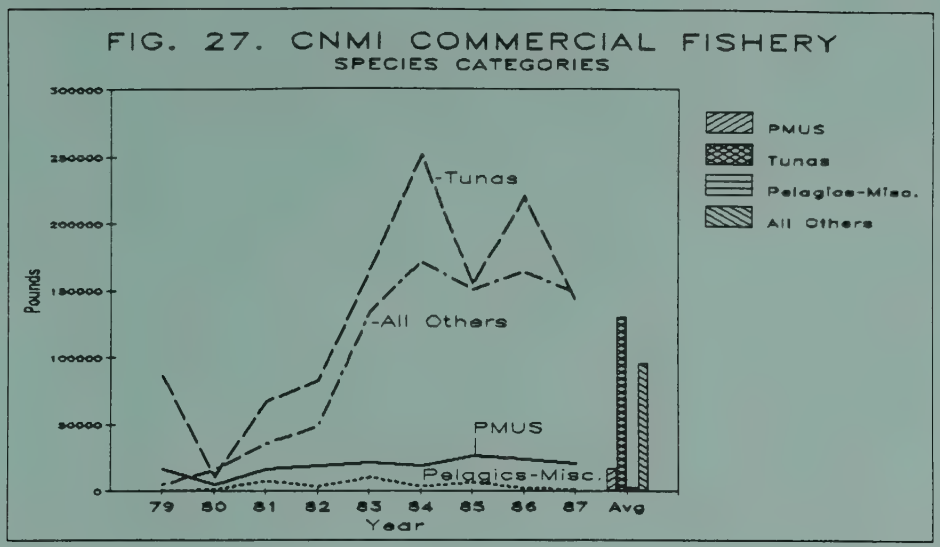


FIG. 27. CNMI COMMERCIAL FISHERY
SPECIES CATEGORIES
Pounds
300000
250000
200000
150000
100000
50000
0
Tunas
All Others
PMUS
Pelagics-Misc.
79
80
81
82
83
84
85
86
87
Avg
Year
PMUS
Tunas
Pelagics-Misc.
All Others

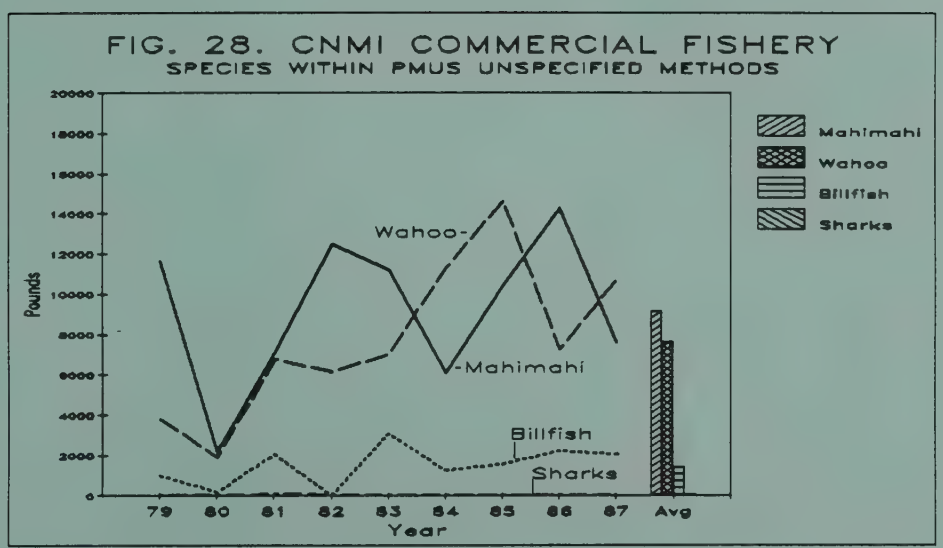


FIG. 28. CNMI COMMERCIAL FISHERY
SPECIES WITHIN PMUS UNSPECIFIED METHODS
Pounds
20000
18000
16000
14000
12000
10000
8000
6000
4000
2000
0
Wahoo
Mahimahi
Billfish
Sharks
79
80
81
82
83
84
85
86
87
Avg
Year
Mahimahi
Wahoo
Billfish
Sharks

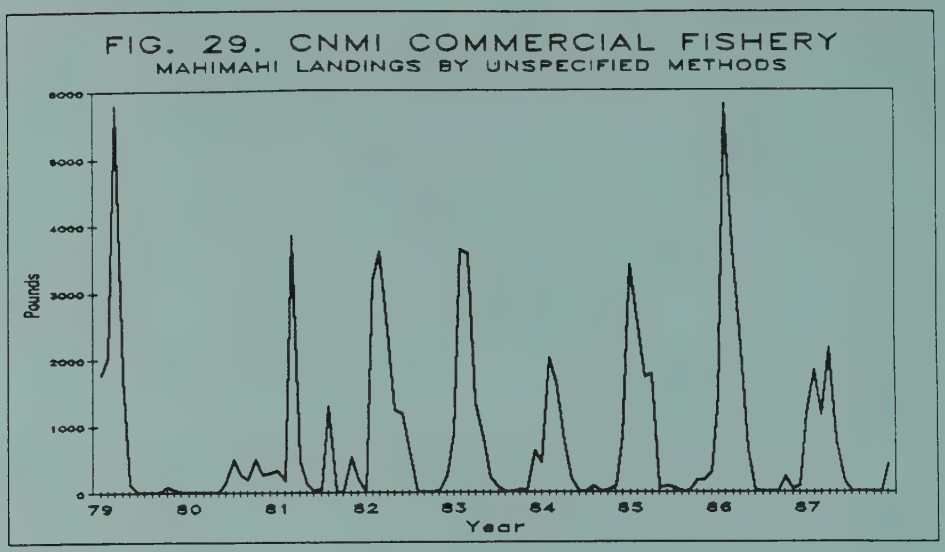


FIG. 29. CNMI COMMERCIAL FISHERY
MAHIMAHI LANDINGS BY UNSPECIFIED METHODS
Pounds
6000
5000
4000
3000
2000
1000
0
79
80
81
82
83
84
85
86
87
Year

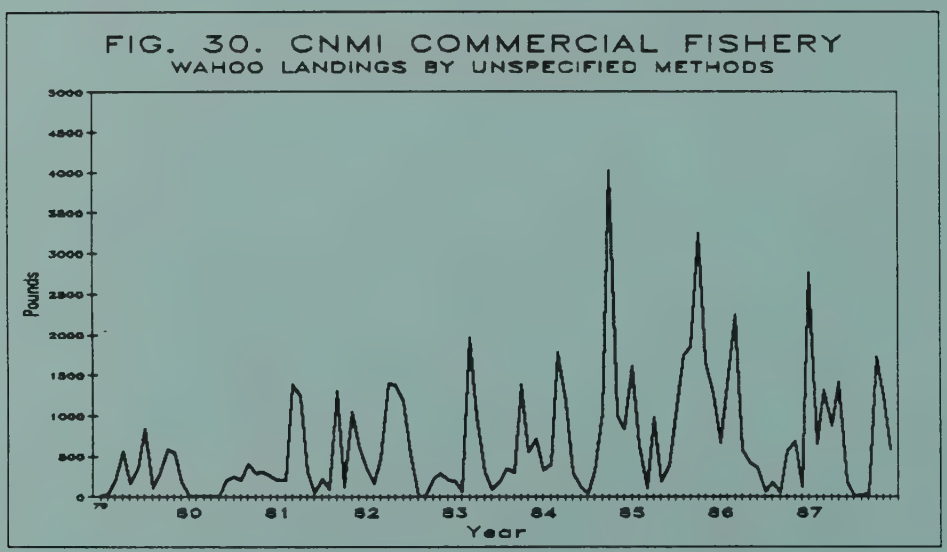


FIG. 30. CNMI COMMERCIAL FISHERY
WAHOO LANDINGS BY UNSPECIFIED METHODS
Pounds
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0
80
81
82
83
84
85
86
87
Year

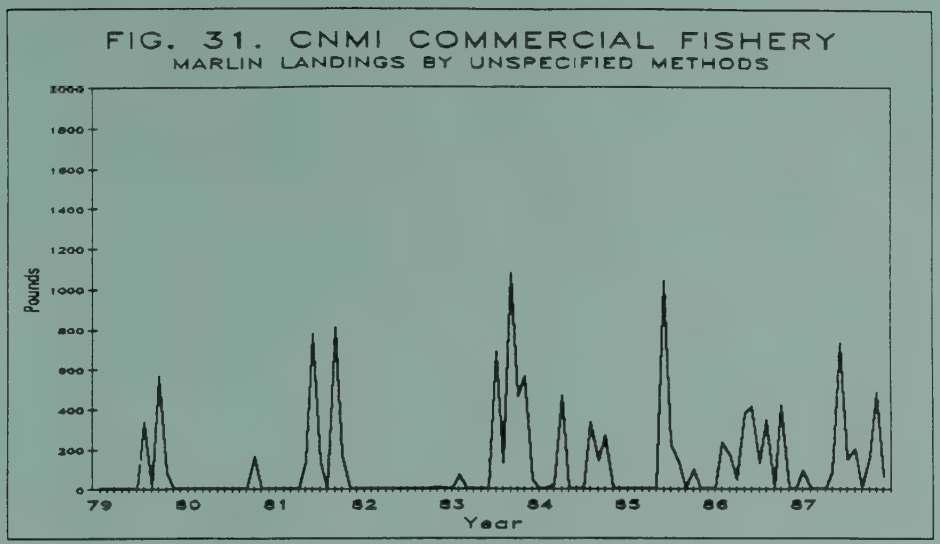


FIG. 31. CNMI COMMERCIAL FISHERY
MARLIN LANDINGS BY UNSPECIFIED METHODS
Pounds
Year
79
80
81
82
83
84
85
86
87

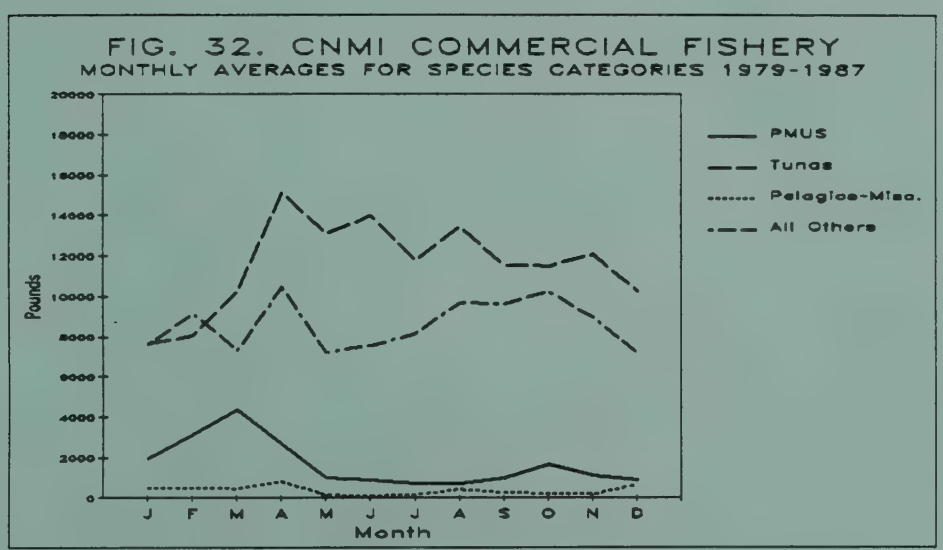


FIG. 32. CNMI COMMERCIAL FISHERY
MONTHLY AVERAGES FOR SPECIES CATEGORIES 1979-1987
Pounds
Month
J F M A M J J A S O N D
PMUS
Tunas
Pelagics-Misc.
All Others

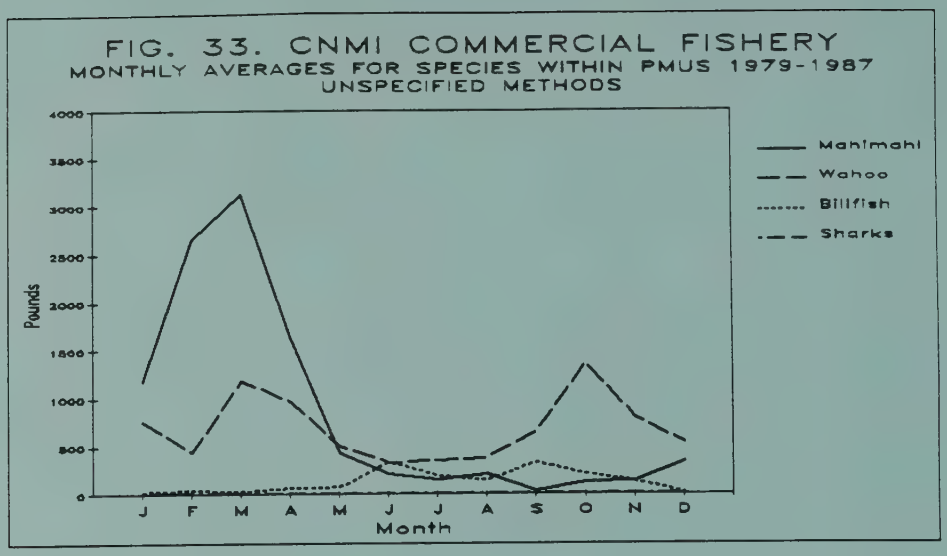


FIG. 33. CNMI COMMERCIAL FISHERY
MONTHLY AVERAGES FOR SPECIES WITHIN PMUS 1979-1987
UNSPECIFIED METHODS
Pounds
4000
3500
3000
2500
2000
1500
1000
500
0
J F M A M J J A S O N D
Month
Mahimahi
Wahoo
Billfish
Sharks

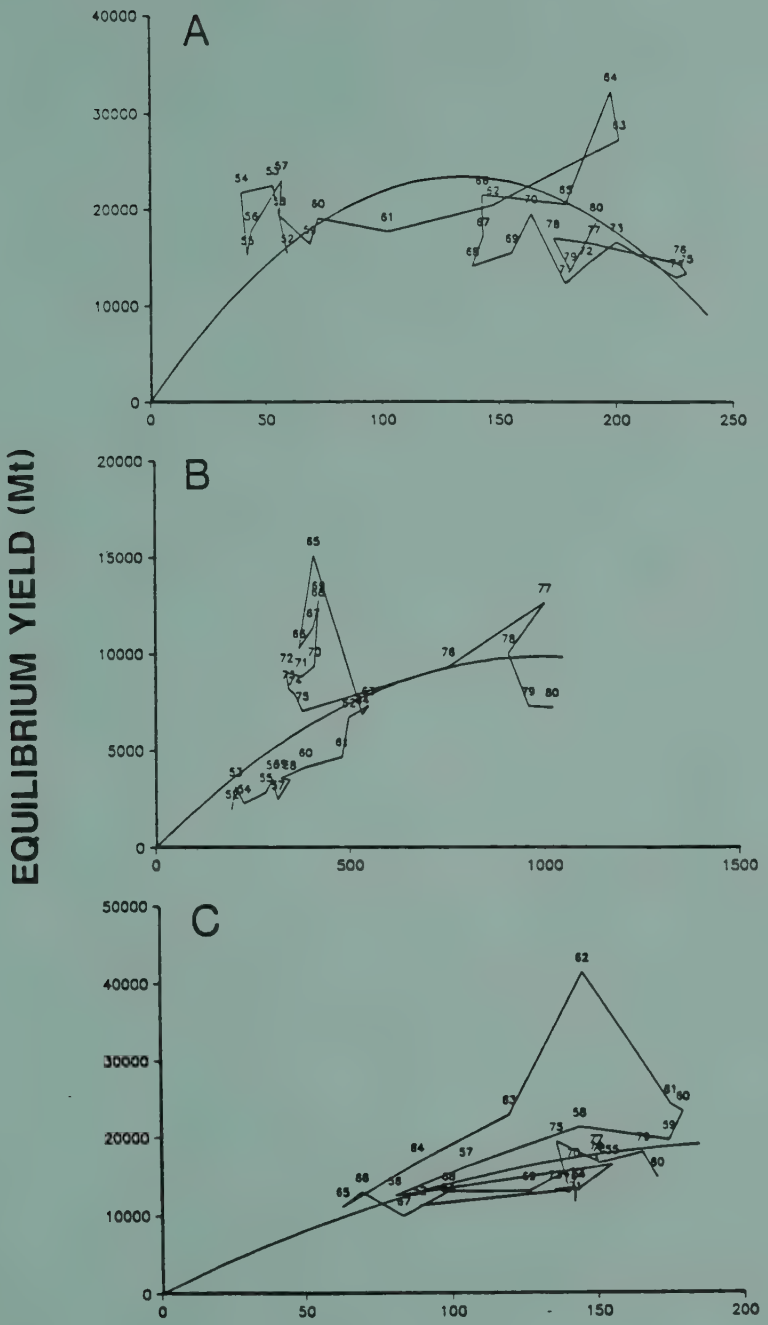


Figure 34. Surplus production model curves with observed (smoothed and adjusted) data for (A) blue marlin, (B) sailfish/spearfish, and (C) swordfish.

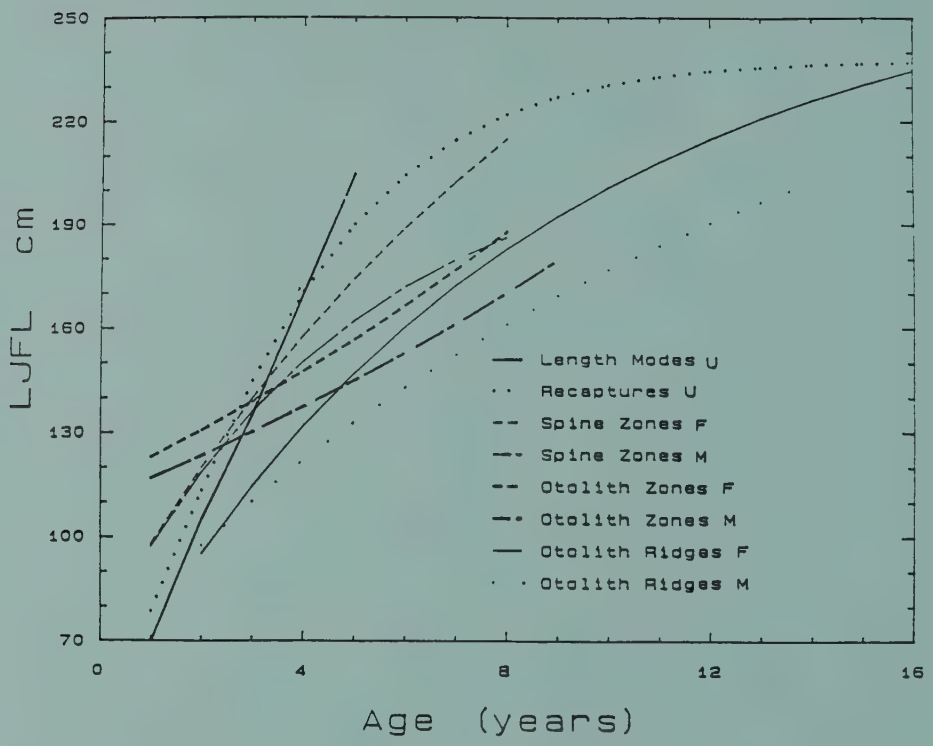


Figure 35. Length (LJFL = lower jaw to fork length) versus age curves for swordfish, Xiphias gladius. M = male, F = female, and U = unknown or unreported.

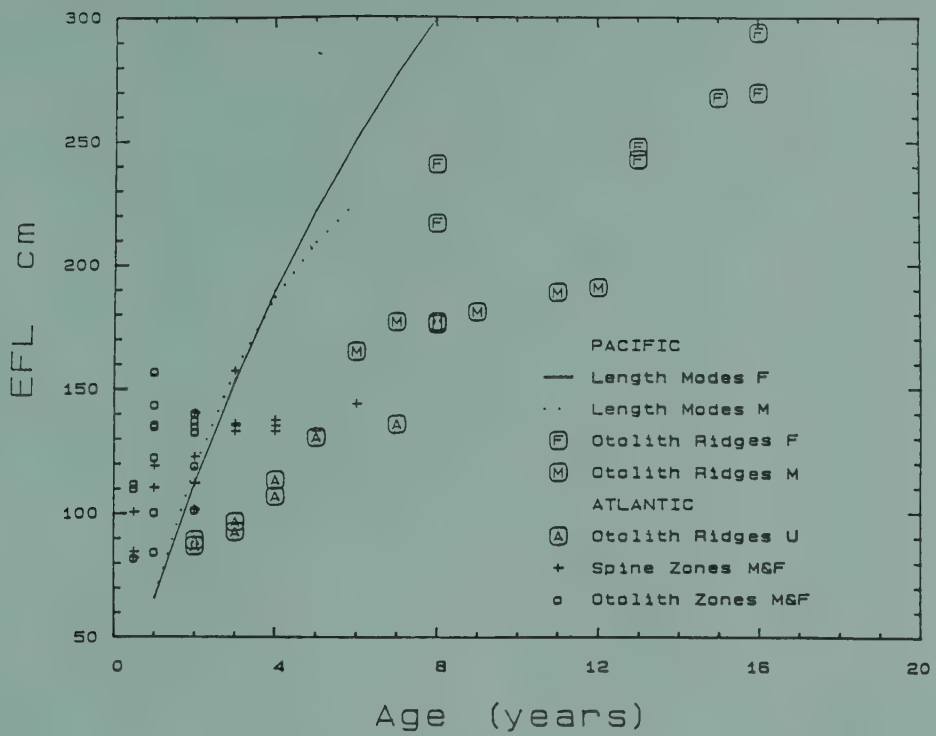


Figure 36. Length (EFL + eye to fork length) versus age data for Pacific blue marlin, Makira mazara, and Atlantic blue marlin, Makira nigricans. M = male, F = female, and U = unknown or unreported.

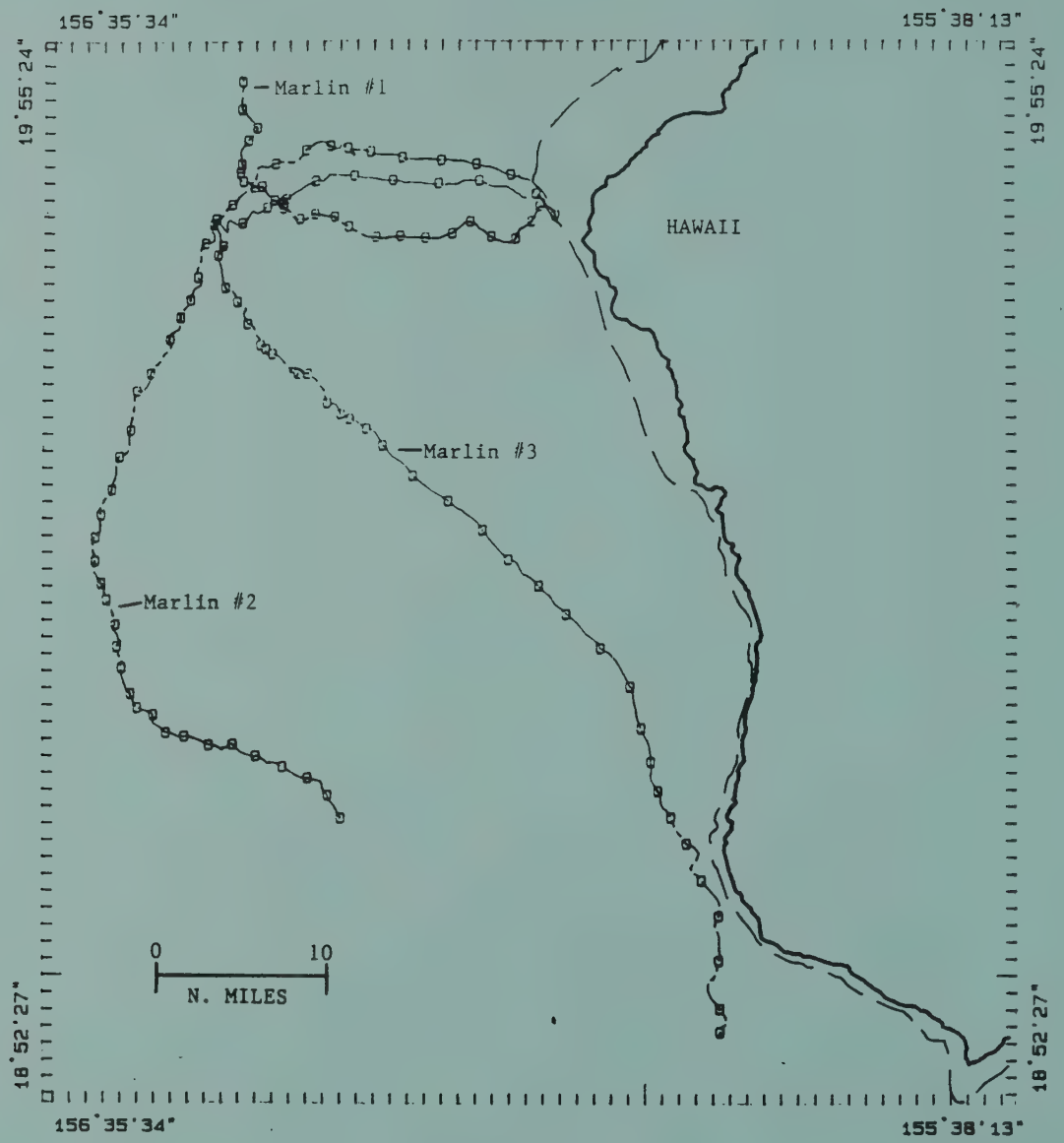


Figure 37. Movement of Indo-Pacific blue marlin carrying sonic tags, off Kailua-Kona, summer 1988.

Depth Distribution of Pacific Blue Marlin

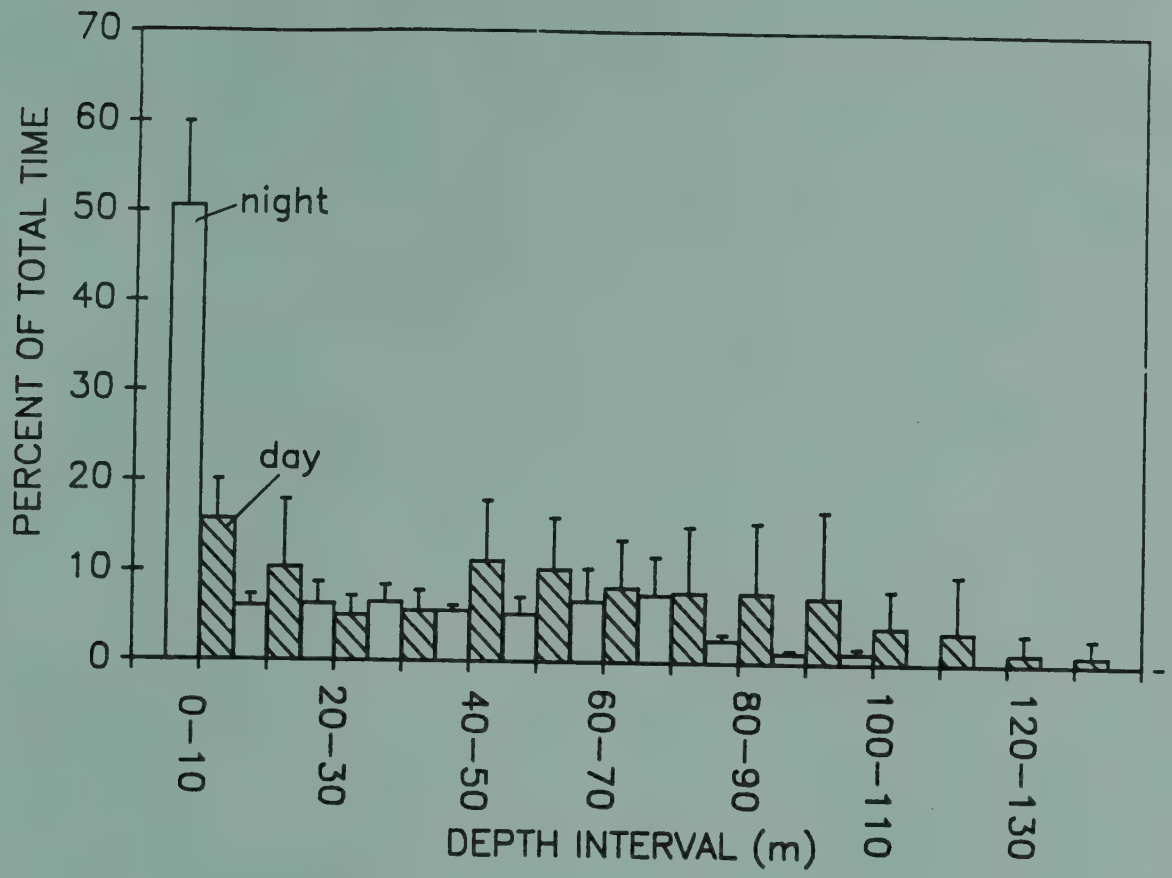


Figure 38. Average depth strata occuppied by three Indo-Pacific blue marlin tracked off Kailua-Kona, summer 1988.

TABLES

Table 1. Trends in Hawaii pelagic landings (in pounds) 1970-87 (Hawaii Division of Aquatic Resources data).

Year	Total	Skipjack tuna	Other tuna	Total tunas	Billfish	Mahimahi ono (wahoo)
1970	9,274,504	7,351,096	1,202,143	8,570,864	583,206	120,434
1971	15,186,761	13,340,812	1,353,011	14,722,401	310,356	154,004
1972	12,759,117	10,917,378	1,347,874	12,301,805	229,195	228,117
1973	12,413,297	10,751,129	1,208,670	11,992,279	230,889	190,129
1974	9,564,237	7,436,153	1,586,187	9,057,114	323,133	183.990
1975	7,870,080	5,054,178	2,161,703	7,281,759	354,146	234,175
1976	12,969,477	9,796,188	2,346,472	12,234,042	426,663	308,772
1977	11,421,919	7,750,335	2,680,100	10,527,133	521,038	373,748
1978	11,215,903	6,794,086	3,277,002	10,149,594	740,569	325,740
1979	8,417,779	5,135,242	2,285,742	7,467,316	582,692	367,771
1980	8,016,028	4,087,646	2,815,611	6,951.543	559,389	505,096
1981	8,334,705	4,124,160	3,097,655	7,259,270	571,891	503,544
1982	6,129,656	2,827,580	2,266,225	5,127,999	567,451	434,206
1983	6,546,792	2,761,636	2,741,917	5,526,842	513,849	506,101
1984	7,112,983	3,652,866	2,408,095	6,095,810	492,802	524,371
1985	5,879,113	2,105,144	2,652,036	4,769,475	433,451	676,187
1986	8,196,723	2,342,610	4,262,017	6,628,866	665,403	902,454
1987	8,679,066	3,448,785	3,585,236	7,034,021	653,375	991,670

Table 2. Hawaii Division of Aquatic Resources landings (in pounds caught and sold), 1987 (revenue and price in dollars) (PMUS = pelagic management unit species).

Pelagic species	Caught	Sold	Revenue	Price
Yellowfin tuna	3,358,619	3,170,556	4,540,670	1.43
Albacore	29,329	28,954	37,254	1.29
Bigeye tuna	197,288	194,518	561,876	2.89
Subtotal	3,585.236	3,394,028	5,139,800	1.51
Skipjack tuna	3,448,785	3,366,764	3,869,532	1.15
Other tuna	24,082	14,631	15,264	1.04
Total all tuna	7,058,103	6,775,423	9,024,596	1.33
Striped marlin	94,346	88,685	121,696	1.37
Blue marlin	521,815	481,624	429,063	0.89
Spearfish and swordfish	37,214	34,599	63,919	1.85
Mahimahi	630,897	600,287	1,365,20[illegible]	2.27
Ono (wahoo)	360,773	340,447	927,847	2.73
Other PMUS[a]	44,572	42,836	30,646	0.72
Total all PMUS	1,689,617	1,588,478	2,938,373	1.85
Total	8,747,720	8,363,901	11,962,969	1.43

[a]Estimated from previous year's share.

Table 3. National Marine Fisheries Service (NMFS) estimates of Hawaii pelagic species landings (pounds and percentages) by gear type in 1987 and Hawaii Division of Aquatic Resources (HDAR) estimates of composition (percentages) in 1986.

Pelagic species	Total	Longline	Troll	Handline[a]	Pole and line
			1987 NMFS		
Bigeye tuna	1,900,701	1,721,609	139,905	39,188	0
Yellowfin tuna	5,564,324	559,532	1,822,371	2,831,923	350,499
Skipjack tuna	4,144,802	3,186	424,417	45,048	3,672,153
Albacore	355,945	314,624	38,149	3,172	0
Other tuna	16,722	77	4,910	249	11,486
Subtotal	11,982,495	2,599,027	2,429,027	2,919,580	4.034,138
Blue marlin	806,264	103,386	667,734	35,144	0
Striped marlin	645,489	569,381	71,541	4.566	0
Other billfish	173,008	153,100	14,733	5,176	0
Subtotal	1,624,761	825,867	754,008	44,887	0
Mahimahi	807,962	44,051	672,242	91,669	0
Ono (wahoo)	384,299	50,606	303.661	30,032	0
Other pelagics	291,617	217,000	68,063	6,554	0
Total	15,091,134	3,736,550	4,227,723	3,092,723	4,034,138
	Percent pelagic landings[b]		**Percent of species group**		
Tuna	79.4	21.7	20.3	24.4	33.7
Billfish	10.8	50.8	46.4	2.8	0
Mahimahi-ono	7.9	7.9	81.8	10.2	0
Total		24.8	28.0	20.5	26.7
			1986 HDAR		
Tuna	85.3	33	19	23	26
Billfish	6.3	15	79	6	0
Mahimahi-ono	8.5	2	87	10	1
Total		29	28	21	22
			Excluding longline landings		
Tuna	80.7		28	34	38
Billfish	7.5		93	7	0
mahimahi-ono	11.7		89	10	1
Total			40	29	31

[a]Handline includes ika shibi, palu ahi, other handline gear, and miscellaneous gears.

[b]Totals may not equal 100% because of rounding or excluding a small percentage of "other gears or pelagic species."

Table 4. Western Pacific foreign fisheries enforcement effort; 1986 and 1987. Source: U.S. Coast Guard, 14th District.

	C-130 AIRCRAFT PATROLS				SURFACE VESSEL PATROLS				TOTAL MILES PATROLLED		FFVS SIGHTED WITHIN US EEZ	
	MILES		HOURS		MILES		DAYS					
MONTH	1986	1987	1986	1987	1986	1987	1986	1987	1986	1987	1986	1987
JANUARY	950	3,501	4.5	14.9	1,793	2,476	6	9	2,743	5,977	0	2
FEBRUARY	11,080	4,884	57.0	22.1	4,211	3,703	24	15	15,291	8,587	8	7
MARCH	11,130	3,645	50.1	16.5	4,996	1,300	31	9	16,126	4,945	11	1
APRIL	2,631	7,425	11.6	33.1	1,756	400	9	4	4,387	7,825	4	4
MAY	8,255	4,887	34.7	20.5	287	2,280	3	10	8,542	7,167	0	2
JUNE	10,223	6,077	41.0	26.6	3,899	4,578	25	21	14,122	10,655	2	4
JULY	6,826	5,980	30.7	26.0	4,289	1,850	14	10	11,115	7,830	0	1
AUGUST	8,656	3,030	42.3	14.1	1,985	1,740	9	9	10,641	4,770	2	0
SEPTEMBER	8,394	8,588	39.8	41.2	1,194	410	9	3	9,588	8,998	1	1
OCTOBER	6,050	7,010	24.2	26.8	241	2,040	1	8	6,291	9,050	4	7
NOVEMBER	8,073	7,257	35.1	32.4	1,150	1,450	4	7	9,223	8,707	11	7
DECEMBER	4,788	4,805	21.0	20.5	0	0	0	0	4,788	4,805	0	0
TOTALS	87,056	67,089	392.0	294.7	25,801	22,227	135	105	112,857	89,316	43	36

Table 5. 1987 foreign fishing vessel sightings.

MONTH	HAWAII				GUAM				AMERICAN SAMOA				OTHER				ALL			
	LL	PL	OT	TOT	LL	PL	OT	TOT	LL	PL	OT	TOT	LL	PL	OT	TOT	LL	PL	OT	TOT
JANUARY	2			2				0				0				0	2	0	0	2
FEBRUARY	7			7				0				0				0	7	0	0	7
MARCH			1	1				0				0				0	0	0	1	1
APRIL	2			2	2			2				0				0	4	0	0	4
MAY	2			2				0				0				0	2	0	0	2
JUNE	4			4				0				0				0	4	0	0	4
JULY		1		1				0				0				0	0	1	0	1
AUGUST				0				0				0				0	0	0	0	0
SEPTEMBER		1		1				0				0				0	0	1	0	1
OCTOBER	2	2		4	2			2				0		1		1	4	3	0	7
NOVEMBER		4		4	3			3				0				0	3	4	0	7
DECEMBER				0				0				0				0	0	0	0	0
TOTALS	19	8	1	28	7	0	0	7	0	0	0	0	0	1	0	1	26	9	1	36

NATIONALITY OF FOREIGN FISHING VESSELS SIGHTED

MONTH	JA	KS	TW	PN	UNK	OTHER	TOTAL
JANUARY	2						2
FEBRUARY	6	1					7
MARCH	1						1
APRIL	4						4
MAY	2						2
JUNE	2	1	1				4
JULY	1						1
AUGUST							0
SEPTEMBER	1						1
OCTOBER	7						7
NOVEMBER	7						7
DECEMBER	0						0
TOTALS	33	2	1	0	0	0	36

KEY

Vessel Type:
LL = longliner
PL = pole and line vessel
OT = other

Nationality:
JA = Japan
KS = Korean
TW = Taiwan
PN = Panama
UNK = Unknown

Table 6. Number of marlin stomachs examined and the percent that were empty. Note that everted stomachs were not examined and were not considered in this analysis.

YEAR	NO. OF STOMACHS	PERCENT EMPTY
1981	44	39
1982	43	12
1983	67	37
1984	99	35
1985	28	25
1986	55	12

Table 7. Source of prey found in HIBT marlin both by percent by numbers and percent by volume. Data from 1981-84.

SOURCE	PERCENT BY NUMBER	PERCENT BY VOLUME
Epipelagic	46	91
Mesopelagic	17	1
"Inshore"	37	8

Table 8. Summary of the food habits of 253 HIBT marlin caught in 1981-84 tournaments.

PREY CATEGORY	PERCENT BY NUMBER	PERCENT BY VOLUME
Squids	38	2
Tunas	16	79
Oceanic Puffers	6	6
Other Species	40	13

APPENDIX I

AMERICAN SAMOA ANNUAL COMMERCIAL LANDINGS OF PELAGICS 1982-87

DATA SOURCE:
AMERICAN SAMOA DEPT. OF MARINE AND WILDLIFE RESOURCES

AMER. SAMOA ANNUAL COMMERCIAL LANDINGS OF PELAGICS

ANNUAL SALES AND REVENUE
BY YEAR, METHOD, AND SPECIES

YEAR	FISHING METHOD	SPECIES	NUMBER TRIPS	WEIGHT (LBS)	REVENUE ($)	PRICE ($/LB)
1982	TROLLING-SURFACE	PMUS TOTAL	18	1298	1243	0.96
		MAHIMAHI	17	742	742	1.00
		WAHOO	4	114	103	0.90
		BLUE MARLIN	1	315	284	0.90
		SAILFISH	1	127	114	0.90
		TUNAS TOTAL	175	21724	18695	0.86
		PELAGICS-MISC. TOTAL	13	833	685	0.82
		RAINBOW RUNNER	4	20	35	1.75
		MISC. TROLL FISH	10	813	650	0.80
		ALL PELAGICS	183	23855	20623	0.86
	BOTTOMFISH	PMUS TOTAL	3	14	25	1.74
		SHARKS	3	14	25	1.74
		TUNAS TOTAL	8	510	509	1.00
		PELAGICS-MISC. TOTAL	28	408	615	1.51
		RAINBOW RUNNER	1	4	7	1.75
		MISC. TROLL FISH	28	404	608	1.51
		ALL PELAGICS	39	932	1149	1.23
	SPEAR	PMUS TOTAL	1	31	54	1.75
		SHARKS	1	31	54	1.75
		ALL PELAGICS	1	31	54	1.75
	ALL GEARS	PMUS TOTAL	23	1343	1322	0.98
		MAHIMAHI	17	742	742	1.00
		WAHOO	4	114	103	0.90
		BLUE MARLIN	1	315	284	0.90
		SAILFISH	1	127	114	0.90
		SHARKS	4	45	79	1.75
		TUNAS TOTAL	182	22234	19204	0.86
		PELAGICS-MISC. TOTAL	41	1241	1300	1.05
		RAINBOW RUNNER	6	24	42	1.75
		MISC. TROLL FISH	38	1217	1258	1.03
		ALL PELAGICS	221	24818	21826	0.88

AMER. SAMOA ANNUAL COMMERCIAL LANDINGS OF PELAGICS
(CONTINUE)

ANNUAL SALES AND REVENUE
BY YEAR, METHOD, AND SPECIES

YEAR	FISHING METHOD	SPECIES	NUMBER TRIPS	WEIGHT (LBS)	REVENUE ($)	PRICE ($/LB)
1983	TROLLING-SURFACE	PMUS TOTAL	46	3150	3950	1.25
		MAHIMAHI	39	1443	2216	1.54
		WAHOO	13	550	800	1.45
		BLUE MARLIN	2	1083	867	0.80
		SAILFISH	2	74	67	0.90
		TUNAS TOTAL	350	70693	49238	0.70
		PELAGICS-MISC. TOTAL	39	842	1184	1.41
		RAINBOW RUNNER	24	654	877	1.34
		MISC. TROLL FISH	20	188	307	1.64
		ALL PELAGICS	359	74685	54372	0.73
	LONGLINE-TUNA	TUNAS TOTAL	4	15056	10254	0.68
		ALL PELAGICS	4	15056	10254	0.68
	BOTTOMFISH	PMUS TOTAL	11	374	633	1.69
		WAHOO	2	81	122	1.50
		SHARKS	9	293	511	1.74
		TUNAS TOTAL	11	237	318	1.34
		PELAGICS-MISC. TOTAL	26	243	422	1.74
		MISC. TROLL FISH	26	243	422	1.74
		ALL PELAGICS	44	854	1373	1.61
	SPEAR	PELAGICS-MISC. TOTAL	6	35	62	1.75
		MISC. TROLL FISH	6	35	62	1.75
		ALL PELAGICS	6	35	62	1.75
	GILL NET-7/10 FT	PELAGICS-MISC. TOTAL	13	113	198	1.75
		MISC. TROLL FISH	13	113	198	1.75
		ALL PELAGICS	13	113	198	1.75
	ALL GEARS	PMUS TOTAL	56	3524	4583	1.30
		MAHIMAHI	39	1443	2216	1.54
		WAHOO	15	631	922	1.46
		BLUE MARLIN	2	1083	867	0.80
		SAILFISH	2	74	67	0.90
		SHARKS	9	293	511	1.74
		TUNAS TOTAL	361	85986	59810	0.70
		PELAGICS-MISC. TOTAL	81	1233	1866	1.51
		RAINBOW RUNNER	24	654	877	1.34
		MISC. TROLL FISH	63	579	989	1.71
		ALL PELAGICS	413	90743	66259	0.73

AMER. SAMOA ANNUAL COMMERCIAL LANDINGS OF PELAGICS

ANNUAL SALES AND REVENUE
BY YEAR, METHOD, AND SPECIES

YEAR	FISHING METHOD	SPECIES	NUMBER TRIPS	WEIGHT (LBS)	REVENUE ($)	PRICE ($/LB)
1984	TROLLING-SURFACE	PMUS TOTAL	70	6432	5205	0.81
		MAHIMAHI	47	1446	1693	1.17
		WAHOO	26	631	730	1.16
		BLUE MARLIN	14	4158	2604	0.63
		SAILFISH	3	197	178	0.90
		TUNAS TOTAL	463	155017	89590	0.58
		PELAGICS-MISC. TOTAL	180	23371	19402	0.83
		RAINBOW RUNNER	72	2111	2179	1.03
		MISC. TROLL FISH	124	21260	17223	0.81
		ALL PELAGICS	567	184820	114197	0.62
	LONGLINE-TUNA	PMUS TOTAL	5	2786	2917	1.05
		MAHIMAHI	5	354	528	1.49
		WAHOO	1	124	175	1.41
		BLUE MARLIN	5	1516	1501	0.99
		SAILFISH	5	792	713	0.90
		TUNAS TOTAL	12	41784	26684	0.64
		ALL PELAGICS	12	44570	29601	0.66
	BOTTOMFISH	PMUS TOTAL	28	1546	4616	2.99
		MAHIMAHI	1	8	9	1.11
		WAHOO	15	815	3343	4.10
		SHARKS	12	723	1264	1.75
		TUNAS TOTAL	15	441	497	1.13
		PELAGICS-MISC. TOTAL	51	531	898	1.69
		RAINBOW RUNNER	14	129	198	1.54
		MISC. TROLL FISH	42	402	700	1.74
		ALL PELAGICS	85	2518	6011	2.39
	TROLLING-BOTTOMFISH	PMUS TOTAL	3	68	81	1.20
		WAHOO	3	68	81	1.20
		TUNAS TOTAL	20	1482	1328	0.90
		PELAGICS-MISC. TOTAL	19	2755	2350	0.85
		RAINBOW RUNNER	3	64	64	1.01
		MISC. TROLL FISH	18	2691	2286	0.85
		ALL PELAGICS	32	4305	3759	0.87

AMER. SAMOA ANNUAL COMMERCIAL LANDINGS OF PELAGICS
(CONTINUE)

ANNUAL SALES AND REVENUE
BY YEAR, METHOD, AND SPECIES

YEAR	FISHING METHOD	SPECIES	NUMBER TRIPS	WEIGHT (LBS)	REVENUE ($)	PRICE ($/LB)
1984	ALL GEARS	PMUS TOTAL	100	10832	12819	1.18
		MAHIMAHI	54	1808	2230	1.23
		WAHOO	45	1638	4329	2.64
		BLUE MARLIN	19	5674	4105	0.72
		SAILFISH	8	989	891	0.90
		SHARKS	12	723	1264	1.75
		TUNAS TOTAL	502	198724	118099	0.59
		PELAGICS-MISC. TOTAL	244	26657	22650	0.85
		RAINBOW RUNNER	86	2304	2441	1.06
		MISC. TROLL FISH	181	24353	20209	0.83
		ALL PELAGICS	667	236213	153568	0.65

AMER. SAMOA ANNUAL COMMERCIAL LANDINGS OF PELAGICS

ANNUAL SALES AND REVENUE
BY YEAR, METHOD, AND SPECIES

YEAR	FISHING METHOD	SPECIES	NUMBER TRIPS	WEIGHT (LBS)	REVENUE ($)	PRICE ($/LB)
1985	TROLLING	TUNAS TOTAL	1	24	24	1.00
		ALL PELAGICS	1	24	24	1.00
	TROLLING-SURFACE	PMUS TOTAL	89	8849	15984	1.81
		MAHIMAHI	64	5354	12531	2.34
		WAHOO	32	1139	1033	0.91
		BLUE MARLIN	5	1621	1621	1.00
		SAILFISH	3	283	283	1.00
		SHARKS	3	452	516	1.14
		TUNAS TOTAL	297	52013	48202	0.93
		PELAGICS-MISC. TOTAL	75	11392	7924	0.70
		RAINBOW RUNNER	20	537	537	1.00
		MISC. TROLL FISH	56	10855	7387	0.68
		ALL PELAGICS	381	72254	72110	1.00
	LONGLINE-TUNA	PMUS TOTAL	10	5597	5484	0.98
		MAHIMAHI	9	1410	1576	1.12
		WAHOO	6	648	369	0.57
		BLUE MARLIN	8	1156	1156	1.00
		SAILFISH	10	2383	2383	1.00
		TUNAS TOTAL	10	41488	41050	0.99
		PELAGICS-MISC. TOTAL	4	215	375	1.74
		MISC. TROLL FISH	4	215	375	1.74
		ALL PELAGICS	10	47300	46909	0.99
	BOTTOMFISH	PMUS TOTAL	10	536	1440	2.69
		MAHIMAHI	4	100	100	1.00
		WAHOO	5	436	1340	3.08
		TUNAS TOTAL	27	577	567	0.98
		PELAGICS-MISC. TOTAL	14	152	236	1.55
		MISC. TROLL FISH	14	152	236	1.55
		ALL PELAGICS	49	1265	2243	1.77
	TROLLING-BOTTOMFISH	PMUS TOTAL	15	1067	1601	1.50
		MAHIMAHI	8	300	669	2.23
		WAHOO	5	115	137	1.19
		SAILFISH	1	78	78	1.00
		SHARKS	3	574	717	1.25
		TUNAS TOTAL	56	6709	6231	0.93
		PELAGICS-MISC. TOTAL	26	1926	1380	0.72
		RAINBOW RUNNER	1	21	21	1.00
		MISC. TROLL FISH	25	1905	1359	0.71
		ALL PELAGICS	86	9702	9212	0.95

AMER. SAMOA ANNUAL COMMERCIAL LANDINGS OF PELAGICS
(CONTINUE)

ANNUAL SALES AND REVENUE
BY YEAR, METHOD, AND SPECIES

YEAR	FISHING METHOD	SPECIES	NUMBER TRIPS	WEIGHT (LBS)	REVENUE ($)	PRICE ($/LB)
1985	STATIC FISHING	PELAGICS-MISC. TOTAL	1	120	84	0.70
		MISC. TROLL FISH	1	120	84	0.70
		ALL PELAGICS	1	120	84	0.70
	ALL GEARS	PMUS TOTAL	124	16049	24509	1.53
		MAHIMAHI	86	7164	14876	2.08
		WAHOO	49	2338	2879	1.23
		BLUE MARLIN	13	2777	2777	1.00
		SAILFISH	14	2744	2744	1.00
		SHARKS	6	1026	1233	1.20
		TUNAS TOTAL	390	100811	96074	0.95
		PELAGICS-MISC. TOTAL	120	13805	9999	0.72
		RAINBOW RUNNER	21	558	558	1.00
		MISC. TROLL FISH	100	13247	9441	0.71
		ALL PELAGICS	525	130665	130582	1.00

AMER. SAMOA ANNUAL COMMERCIAL LANDINGS OF PELAGICS

ANNUAL SALES AND REVENUE
BY YEAR, METHOD, AND SPECIES

YEAR	FISHING METHOD	SPECIES	NUMBER TRIPS	WEIGHT (LBS)	REVENUE ($)	PRICE ($/LB)
1986	TROLLING-SURFACE	PMUS TOTAL	175	14060	19396	1.38
		MAHIMAHI	139	8461	13194	1.56
		WAHOO	33	1256	1733	1.38
		BLUE MARLIN	23	3567	3693	1.04
		SAILFISH	3	99	99	1.00
		SHARKS	4	677	677	1.00
		TUNAS TOTAL	705	149268	121892	0.82
		PELAGICS-MISC. TOTAL	12	289	346	1.20
		RAINBOW RUNNER	8	126	136	1.08
		MISC. TROLL FISH	6	163	210	1.29
		ALL PELAGICS	728	163617	141634	0.87
	BOTTOMFISH	PMUS TOTAL	4	128	182	1.42
		WAHOO	3	104	151	1.45
		SHARKS	1	24	31	1.28
		TUNAS TOTAL	8	379	488	1.29
		PELAGICS-MISC. TOTAL	7	379	310	0.82
		MISC. TROLL FISH	7	379	310	0.82
		ALL PELAGICS	19	886	980	1.11
	TROLLING-BOTTOMFISH	PMUS TOTAL	53	3431	4763	1.39
		MAHIMAHI	48	1943	2584	1.33
		WAHOO	16	952	1375	1.44
		BLUE MARLIN	3	499	748	1.50
		SHARKS	1	37	56	1.50
		TUNAS TOTAL	269	21784	18886	0.87
		PELAGICS-MISC. TOTAL	9	349	354	1.01
		RAINBOW RUNNER	3	65	65	1.00
		MISC. TROLL FISH	6	284	289	1.02
		ALL PELAGICS	279	25564	24003	0.94
	ALL GEARS	PMUS TOTAL	230	17619	24341	1.38
		MAHIMAHI	186	10404	15778	1.52
		WAHOO	51	2312	3259	1.41
		BLUE MARLIN	26	4066	4441	1.09
		SAILFISH	3	99	99	1.00
		SHARKS	6	738	764	1.03
		TUNAS TOTAL	973	171431	141266	0.82
		PELAGICS-MISC. TOTAL	26	1017	1010	0.99
		RAINBOW RUNNER	11	191	201	1.06
		MISC. TROLL FISH	17	826	809	0.98
		ALL PELAGICS	1014	190067	166617	0.88

AMER. SAMOA ANNUAL COMMERCIAL LANDINGS OF PELAGICS

ANNUAL SALES AND REVENUE
BY YEAR, METHOD, AND SPECIES

YEAR	FISHING METHOD	SPECIES	NUMBER TRIPS	WEIGHT (LBS)	REVENUE ($)	PRICE ($/LB)
1987	TROLLING-SURFACE	PMUS TOTAL	63	4394	4909	1.12
		MAHIMAHI	49	2264	2838	1.25
		WAHOO	21	974	915	0.94
		SAILFISH	6	1156	1156	1.00
		TUNAS TOTAL	498	120772	97221	0.80
		PELAGICS-MISC. TOTAL	12	202	275	1.36
		RAINBOW RUNNER	4	19	15	0.80
		MISC. TROLL FISH	8	183	260	1.42
		ALL PELAGICS	504	125368	102405	0.82
	BOTTOMFISH	PMUS TOTAL	2	157	517	3.30
		WAHOO	2	157	517	3.30
		TUNAS TOTAL	7	154	189	1.22
		ALL PELAGICS	9	311	706	2.27
	TROLLING-BOTTOMFISH	PMUS TOTAL	10	532	729	1.37
		MAHIMAHI	4	125	125	1.00
		WAHOO	6	175	418	2.39
		BLUE MARLIN	3	232	186	0.80
		TUNAS TOTAL	143	12063	12970	1.08
		ALL PELAGICS	143	12595	13699	1.09
	ALL GEARS	PMUS TOTAL	75	5083	6155	1.21
		MAHIMAHI	52	2389	2963	1.24
		WAHOO	30	1306	1850	1.42
		BLUE MARLIN	3	232	186	0.80
		SAILFISH	6	1156	1156	1.00
		TUNAS TOTAL	647	132989	110380	0.83
		PELAGICS-MISC. TOTAL	12	202	275	1.36
		RAINBOW RUNNER	4	19	15	0.80
		MISC. TROLL FISH	8	183	260	1.42
		ALL PELAGICS	656	138274	116810	0.84

APPENDIX II

GUAM ANNUAL COMMERCIAL LANDINGS OF PELAGICS
1979-87

DATA SOURCE:
NOAA FISHERIES, WESTERN PACIFIC FISHERY INFORMATION NETWORK

GUAM ANNUAL COMMERCIAL LANDINGS OF PELAGICS

ANNUAL SALES AND REVENUE
BY YEAR, METHOD, AND SPECIES

YEAR	FISHING METHOD	SPECIES	NUMBER TRIPS	WEIGHT (LBS)	REVENUE ($)	PRICE ($/LB)
1979	UNSPECIFIED	PMUS TOTAL	103	7259	8087	1.11
		MAHIMAHI	35	793	992	1.25
		WAHOO	66	3227	4049	1.25
		SAILFISH	2	98	107	1.09
		MARLIN-UNSPECIFIED	17	3141	2939	0.94
		TUNAS TOTAL	125	8432	10099	1.20
		PELAGICS-MISC. TOTAL	49	2914	3643	1.25
		RAINBOW RUNNER	13	232	290	1.25
		MISC. TROLL FISH	38	2682	3353	1.25
		ALL PELAGICS	205	18605	21829	1.17
1980	UNSPECIFIED	PMUS TOTAL	576	51816	66609	1.29
		MAHIMAHI	332	26338	32968	1.25
		WAHOO	256	10631	15845	1.49
		SAILFISH	5	262	328	1.25
		MARLIN-UNSPECIFIED	107	14585	17468	1.20
		TUNAS TOTAL	482	34707	42123	1.21
		PELAGICS-MISC. TOTAL	109	2185	3138	1.44
		RAINBOW RUNNER	31	523	683	1.31
		MISC. TROLL FISH	82	1662	2455	1.48
		ALL PELAGICS	837	88708	111870	1.26

GUAM ANNUAL COMMERCIAL LANDINGS OF PELAGICS

ANNUAL SALES AND REVENUE
BY YEAR, METHOD, AND SPECIES

YEAR	FISHING METHOD	SPECIES	NUMBER TRIPS	WEIGHT (LBS)	REVENUE ($)	PRICE ($/LB)
1981	UNSPECIFIED	PMUS TOTAL	727	65446	90571	1.38
		MAHIMAHI	312	15540	23261	1.50
		WAHOO	466	27305	40933	1.50
		SAILFISH	11	587	770	1.31
		MARLIN-UNSPECIFIED	138	21635	25417	1.17
		SHARKS	9	379	190	0.50
		TUNAS TOTAL	694	59833	77404	1.29
		PELAGICS-MISC. TOTAL	225	4469	6734	1.51
		RAINBOW RUNNER	118	2256	3393	1.50
		MISC. TROLL FISH	128	2213	3341	1.51
		ALL PELAGICS	1089	129748	174709	1.35
1982	UNSPECIFIED	PMUS TOTAL	526	50053	69093	1.38
		MAHIMAHI	367	30996	44569	1.44
		WAHOO	194	7582	11433	1.51
		SAILFISH	3	161	201	1.25
		MARLIN-UNSPECIFIED	68	10641	12549	1.18
		SHARKS	16	673	341	0.51
		TUNAS TOTAL	387	39331	48720	1.24
		PELAGICS-MISC. TOTAL	106	2160	3303	1.53
		RAINBOW RUNNER	16	161	242	1.50
		MISC. TROLL FISH	93	1999	3061	1.53
		ALL PELAGICS	715	91544	121116	1.32
	TROLLING	PMUS TOTAL	174	13059	18354	1.41
		MAHIMAHI	81	3066	4659	1.52
		WAHOO	125	6706	9966	1.49
		SAILFISH	1	84	104	1.25
		MARLIN-UNSPECIFIED	20	2994	3520	1.18
		SHARKS	6	209	105	0.50
		TUNAS TOTAL	218	23452	30341	1.29
		PELAGICS-MISC. TOTAL	46	839	1290	1.54
		RAINBOW RUNNER	18	234	353	1.51
		MISC. TROLL FISH	32	605	937	1.55
		ALL PELAGICS	273	37350	49985	1.34
	JIGGING	PMUS TOTAL	1	117	176	1.50
		WAHOO	1	117	176	1.50
		TUNAS TOTAL	2	495	695	1.40
		PELAGICS-MISC. TOTAL	1	11	16	1.50
		MISC. TROLL FISH	1	11	16	1.50
		ALL PELAGICS	2	623	887	1.42

GUAM ANNUAL COMMERCIAL LANDINGS OF PELAGICS
(CONTINUE)

ANNUAL SALES AND REVENUE
BY YEAR, METHOD, AND SPECIES

YEAR	FISHING METHOD	SPECIES	NUMBER TRIPS	WEIGHT (LBS)	REVENUE ($)	PRICE ($/LB)
1982	IKA SHIBI	PMUS TOTAL	1	66	46	0.69
		MAHIMAHI	1	13	19	1.50
		SHARKS	1	53	27	0.50
		TUNAS TOTAL	1	9	13	1.50
		PELAGICS-MISC. TOTAL	1	10	15	1.50
		MISC. TROLL FISH	1	10	15	1.50
		ALL PELAGICS	1	85	74	0.87
	LONGLINE-TUNA	PMUS TOTAL	1	48	24	0.50
		SHARKS	1	48	24	0.50
		TUNAS TOTAL	2	231	373	1.62
		ALL PELAGICS	3	279	397	1.43
	BOTTOMFISH-SHALLOW	PMUS TOTAL	6	201	198	0.99
		MAHIMAHI	1	36	54	1.50
		WAHOO	3	65	94	1.45
		SHARKS	3	100	50	0.50
		TUNAS TOTAL	4	301	436	1.45
		PELAGICS-MISC. TOTAL	5	42	62	1.50
		RAINBOW RUNNER	1	4	5	1.50
		MISC. TROLL FISH	5	38	57	1.50
		ALL PELAGICS	10	544	696	1.28
	BOTTOMFISH-DEEP	PMUS TOTAL	2	66	51	0.78
		MAHIMAHI	1	8	12	1.50
		WAHOO	1	10	15	1.50
		SHARKS	1	48	24	0.50
		TUNAS TOTAL	1	31	31	1.00
		PELAGICS-MISC. TOTAL	1	24	35	1.50
		MISC. TROLL FISH	1	24	35	1.50
		ALL PELAGICS	3	121	117	0.98
	ALL GEARS	PMUS TOTAL	711	63610	87942	1.38
		MAHIMAHI	451	34119	49313	1.45
		WAHOO	324	14480	21684	1.50
		SAILFISH	4	245	305	1.25
		MARLIN-UNSPECIFIED	88	13635	16069	1.18
		SHARKS	28	1131	571	0.50
		TUNAS TOTAL	615	63850	80609	1.26
		PELAGICS-MISC. TOTAL	160	3086	4721	1.53
		RAINBOW RUNNER	35	399	600	1.51
		MISC. TROLL FISH	133	2687	4121	1.53
		ALL PELAGICS	1007	130546	173272	1.33

GUAM ANNUAL COMMERCIAL LANDINGS OF PELAGICS

ANNUAL SALES AND REVENUE
BY YEAR, METHOD, AND SPECIES

YEAR	FISHING METHOD	SPECIES	NUMBER TRIPS	WEIGHT (LBS)	REVENUE ($)	PRICE ($/LB)
1983	UNSPECIFIED	PMUS TOTAL	204	23759	32983	1.39
		MAHIMAHI	153	13694	18792	1.37
		WAHOO	110	8117	12202	1.50
		SHORTBILL SPEARFISH	1	38	38	1.00
		SAILFISH	4	201	230	1.14
		MARLIN-UNSPECIFIED	13	1463	1594	1.09
		SHARKS	4	246	127	0.52
		TUNAS TOTAL	134	8066	9173	1.14
		PELAGICS-MISC. TOTAL	28	702	852	1.21
		RAINBOW RUNNER	8	141	189	1.34
		MISC. TROLL FISH	22	561	663	1.18
		ALL PELAGICS	224	32527	43008	1.32
	TROLLING	PMUS TOTAL	1266	146010	200203	1.37
		MAHIMAHI	899	83756	116954	1.40
		WAHOO	629	41041	59535	1.45
		SAILFISH	19	1225	1515	1.24
		MARLIN-UNSPECIFIED	119	18878	21644	1.15
		SHARKS	26	1110	555	0.50
		TUNAS TOTAL	891	66237	83309	1.26
		PELAGICS-MISC. TOTAL	203	3565	4686	1.31
		RAINBOW RUNNER	70	963	1427	1.48
		MISC. TROLL FISH	148	2602	3259	1.25
		ALL PELAGICS	1492	215812	288198	1.34
	JIGGING	PMUS TOTAL	6	227	318	1.41
		MAHIMAHI	3	50	75	1.50
		WAHOO	5	159	234	1.48
		SHARKS	1	18	9	0.50
		TUNAS TOTAL	5	220	288	1.31
		PELAGICS-MISC. TOTAL	1	2	3	1.25
		MISC. TROLL FISH	1	2	3	1.25
		ALL PELAGICS	9	449	609	1.36
	IKA SHIBI	PMUS TOTAL	1	72	76	1.06
		WAHOO	1	40	60	1.50
		SHARKS	1	32	16	0.50
		TUNAS TOTAL	2	1599	2450	1.53
		ALL PELAGICS	2	1671	2526	1.51

GUAM ANNUAL COMMERCIAL LANDINGS OF PELAGICS
(CONTINUE)

ANNUAL SALES AND REVENUE
BY YEAR, METHOD, AND SPECIES

YEAR	FISHING METHOD	SPECIES	NUMBER TRIPS	WEIGHT (LBS)	REVENUE ($)	PRICE ($/LB)
1983	LONGLINE-TUNA	PMUS TOTAL	5	595	685	1.15
		MAHIMAHI	3	290	427	1.47
		WAHOO	1	22	32	1.50
		MARLIN-UNSPECIFIED	1	112	140	1.25
		SHARKS	3	171	86	0.50
		TUNAS TOTAL	4	376	566	1.51
		ALL PELAGICS	6	971	1251	1.29
	BOTTOMFISH-SHALLOW	PMUS TOTAL	6	262	298	1.14
		MAHIMAHI	3	103	132	1.28
		WAHOO	1	15	19	1.25
		MARLIN-UNSPECIFIED	1	100	125	1.25
		SHARKS	2	44	22	0.50
		TUNAS TOTAL	5	251	283	1.13
		PELAGICS-MISC. TOTAL	4	53	65	1.22
		RAINBOW RUNNER	2	6	9	1.50
		MISC. TROLL FISH	2	47	56	1.18
		ALL PELAGICS	11	566	646	1.14
	BOTTOMFISH-DEEP	PMUS TOTAL	18	1351	1644	1.22
		MAHIMAHI	11	527	741	1.41
		WAHOO	7	274	399	1.46
		MARLIN-UNSPECIFIED	3	336	397	1.18
		SHARKS	6	214	107	0.50
		TUNAS TOTAL	22	2695	3555	1.32
		PELAGICS-MISC. TOTAL	14	324	435	1.34
		RAINBOW RUNNER	8	188	281	1.49
		MISC. TROLL FISH	10	136	154	1.13
		ALL PELAGICS	35	4370	5634	1.29
	SPEAR	PMUS TOTAL	3	133	195	1.47
		MAHIMAHI	3	133	195	1.47
		PELAGICS-MISC. TOTAL	1	8	9	1.25
		MISC. TROLL FISH	1	8	9	1.25
		ALL PELAGICS	4	141	204	1.46
	OTHER	PMUS TOTAL	2	102	134	1.31
		MAHIMAHI	1	88	127	1.44
		SHARKS	1	14	7	0.50
		ALL PELAGICS	2	102	134	1.31

GUAM ANNUAL COMMERCIAL LANDINGS OF PELAGICS
(CONTINUE)

ANNUAL SALES AND REVENUE
BY YEAR, METHOD, AND SPECIES

YEAR	FISHING METHOD	SPECIES	NUMBER TRIPS	WEIGHT (LBS)	REVENUE ($)	PRICE ($/LB)
1983	ALL GEARS	PMUS TOTAL	1511	172511	236536	1.37
		MAHIMAHI	1076	98641	137443	1.39
		WAHOO	754	49668	72481	1.46
		SHORTBILL SPEARFISH	1	38	38	1.00
		SAILFISH	23	1426	1745	1.22
		MARLIN-UNSPECIFIED	137	20889	23900	1.14
		SHARKS	44	1849	929	0.50
		TUNAS TOTAL	1063	79444	99624	1.25
		PELAGICS-MISC. TOTAL	251	4654	6050	1.30
		RAINBOW RUNNER	88	1298	1906	1.47
		MISC. TROLL FISH	184	3356	4144	1.23
		ALL PELAGICS	1785	256609	342210	1.33

GUAM ANNUAL COMMERCIAL LANDINGS OF PELAGICS

ANNUAL SALES AND REVENUE
BY YEAR, METHOD, AND SPECIES

YEAR	FISHING METHOD	SPECIES	NUMBER TRIPS	WEIGHT (LBS)	REVENUE ($)	PRICE ($/LB)
1984	UNSPECIFIED	PMUS TOTAL	259	27768	39415	1.42
		MAHIMAHI	181	12324	17443	1.42
		WAHOO	152	11479	17830	1.55
		SHORTBILL SPEARFISH	1	20	20	1.00
		SAILFISH	1	20	25	1.25
		MARLIN-UNSPECIFIED	21	3748	3979	1.06
		SHARKS	6	177	118	0.67
		TUNAS TOTAL	304	29164	34027	1.17
		PELAGICS-MISC. TOTAL	66	1395	1921	1.38
		RAINBOW RUNNER	19	226	317	1.40
		MISC. TROLL FISH	57	1169	1604	1.37
		ALL PELAGICS	399	58327	75363	1.29
	TROLLING	PMUS TOTAL	696	64210	92148	1.44
		MAHIMAHI	211	7981	13571	1.70
		WAHOO	493	29490	51691	1.75
		SAILFISH	8	407	542	1.33
		MARLIN-UNSPECIFIED	160	26137	26251	1.00
		SHARKS	6	195	93	0.48
		TUNAS TOTAL	695	70520	86166	1.22
		PELAGICS-MISC. TOTAL	165	2043	2755	1.35
		RAINBOW RUNNER	44	358	535	1.49
		MISC. TROLL FISH	136	1685	2220	1.32
		ALL PELAGICS	1034	136773	181069	1.32
	JIGGING	PMUS TOTAL	1	58	29	0.50
		SHARKS	1	58	29	0.50
		TUNAS TOTAL	9	420	596	1.42
		PELAGICS-MISC. TOTAL	21	286	361	1.26
		MISC. TROLL FISH	21	286	361	1.26
		ALL PELAGICS	27	764	986	1.29
	BOTTOMFISH-SHALLOW	PMUS TOTAL	2	63	51	0.82
		SHARKS	2	63	51	0.82
		TUNAS TOTAL	2	24	32	1.32
		PELAGICS-MISC. TOTAL	5	58	73	1.28
		MISC. TROLL FISH	5	58	73	1.28
		ALL PELAGICS	8	145	156	1.09
	BOTTOMFISH-DEEP	PMUS TOTAL	1	29	14	0.50
		SHARKS	1	29	14	0.50
		TUNAS TOTAL	5	97	124	1.27
		ALL PELAGICS	6	126	138	1.10

GUAM ANNUAL COMMERCIAL LANDINGS OF PELAGICS
(CONTINUE)

ANNUAL SALES AND REVENUE
BY YEAR, METHOD, AND SPECIES

YEAR	FISHING METHOD	SPECIES	NUMBER TRIPS	WEIGHT (LBS)	REVENUE ($)	PRICE ($/LB)
1984	SPEAR	PMUS TOTAL	2	31	47	1.50
		MAHIMAHI	2	31	47	1.50
		TUNAS TOTAL	1	6	9	1.50
		PELAGICS-MISC. TOTAL	2	28	35	1.25
		MISC. TROLL FISH	2	28	35	1.25
		ALL PELAGICS	5	65	91	1.39
	NET	TUNAS TOTAL	2	19	25	1.32
		PELAGICS-MISC. TOTAL	1	9	11	1.25
		MISC. TROLL FISH	1	9	11	1.25
		ALL PELAGICS	3	28	36	1.30
	ALL GEARS	PMUS TOTAL	958	92159	131704	1.43
		MAHIMAHI	394	20336	31061	1.53
		WAHOO	645	40969	69521	1.70
		SHORTBILL SPEARFISH	1	20	20	1.00
		SAILFISH	9	427	567	1.33
		MARLIN-UNSPECIFIED	181	29885	30230	1.01
		SHARKS	16	522	305	0.59
		TUNAS TOTAL	1018	100250	120979	1.21
		PELAGICS-MISC. TOTAL	260	3819	5156	1.35
		RAINBOW RUNNER	63	584	852	1.46
		MISC. TROLL FISH	222	3235	4304	1.33
		ALL PELAGICS	1479	196228	257839	1.31

GUAM ANNUAL COMMERCIAL LANDINGS OF PELAGICS

ANNUAL SALES AND REVENUE
BY YEAR, METHOD, AND SPECIES

YEAR	FISHING METHOD	SPECIES	NUMBER TRIPS	WEIGHT (LBS)	REVENUE ($)	PRICE ($/LB)
1985	UNSPECIFIED	PMUS TOTAL	70	7204	12227	1.70
		MAHIMAHI	58	4918	8153	1.66
		WAHOO	38	2053	3783	1.84
		MARLIN-UNSPECIFIED	2	233	291	1.25
		TUNAS TOTAL	47	2055	2650	1.29
		PELAGICS-MISC. TOTAL	12	118	171	1.44
		RAINBOW RUNNER	1	5	8	1.50
		MISC. TROLL FISH	12	113	163	1.44
		ALL PELAGICS	82	9377	15048	1.60
	TROLLING	PMUS TOTAL	1244	124110	206992	1.67
		MAHIMAHI	591	40627	76361	1.88
		WAHOO	953	62700	112085	1.79
		SHORTBILL SPEARFISH	2	44	61	1.38
		SAILFISH	7	355	406	1.15
		MARLIN-UNSPECIFIED	111	20284	17993	0.89
		SHARKS	2	100	86	0.86
		TUNAS TOTAL	944	74659	106384	1.42
		PELAGICS-MISC. TOTAL	259	4546	6252	1.38
		RAINBOW RUNNER	69	805	1239	1.54
		MISC. TROLL FISH	204	3741	5013	1.34
		ALL PELAGICS	1581	203315	319628	1.57
	JIGGING	TUNAS TOTAL	2	12	18	1.47
		PELAGICS-MISC. TOTAL	14	196	262	1.34
		MISC. TROLL FISH	14	196	262	1.34
		ALL PELAGICS	15	208	280	1.35
	BOTTOMFISH-SHALLOW	PMUS TOTAL	4	92	180	1.97
		MAHIMAHI	1	17	33	2.00
		WAHOO	2	54	108	2.00
		MARLIN-UNSPECIFIED	1	21	39	1.85
		TUNAS TOTAL	4	129	142	1.10
		PELAGICS-MISC. TOTAL	6	104	146	1.40
		MISC. TROLL FISH	6	104	146	1.40
		ALL PELAGICS	13	325	468	1.44

GUAM ANNUAL COMMERCIAL LANDINGS OF PELAGICS
(CONTINUE)

ANNUAL SALES AND REVENUE
BY YEAR, METHOD, AND SPECIES

YEAR	FISHING METHOD	SPECIES	NUMBER TRIPS	WEIGHT (LBS)	REVENUE ($)	PRICE ($/LB)
1985	BOTTOMFISH-DEEP	PMUS TOTAL	2	137	55	0.40
		SHARKS	2	137	55	0.40
		TUNAS TOTAL	2	60	103	1.72
		PELAGICS-MISC. TOTAL	2	21	27	1.33
		RAINBOW RUNNER	1	7	10	1.50
		MISC. TROLL FISH	1	14	17	1.25
		ALL PELAGICS	6	218	185	0.85
	SPEAR	PMUS TOTAL	10	460	850	1.85
		MAHIMAHI	5	227	421	1.86
		WAHOO	7	233	429	1.84
		TUNAS TOTAL	7	58	87	1.50
		PELAGICS-MISC. TOTAL	4	48	68	1.42
		MISC. TROLL FISH	4	48	68	1.42
		ALL PELAGICS	20	566	1005	1.78
	NET	PMUS TOTAL	1	40	74	1.85
		MAHIMAHI	1	40	74	1.85
		TUNAS TOTAL	1	118	166	1.41
		ALL PELAGICS	2	158	240	1.52
	OTHER	TUNAS TOTAL	1	15	23	1.50
		ALL PELAGICS	1	15	23	1.50
	ALL GEARS	PMUS TOTAL	1329	132043	220378	1.67
		MAHIMAHI	656	45829	85042	1.86
		WAHOO	1000	65040	116405	1.79
		SHORTBILL SPEARFISH	2	44	61	1.38
		SAILFISH	7	355	406	1.15
		MARLIN-UNSPECIFIED	114	20538	18323	0.89
		SHARKS	4	237	141	0.59
		TUNAS TOTAL	1008	77106	109573	1.42
		PELAGICS-MISC. TOTAL	297	5033	6926	1.38
		RAINBOW RUNNER	71	817	1257	1.54
		MISC. TROLL FISH	241	4216	5669	1.34
		ALL PELAGICS	1718	214182	336877	1.57

GUAM ANNUAL COMMERCIAL LANDINGS OF PELAGICS

ANNUAL SALES AND REVENUE
BY YEAR, METHOD, AND SPECIES

YEAR	FISHING METHOD	SPECIES	NUMBER TRIPS	WEIGHT (LBS)	REVENUE ($)	PRICE ($/LB)
1986	UNSPECIFIED	PMUS TOTAL	5	441	668	1.52
		MAHIMAHI	4	355	512	1.44
		WAHOO	3	86	156	1.82
		TUNAS TOTAL	2	84	97	1.16
		PELAGICS-MISC. TOTAL	1	27	41	1.50
		MISC. TROLL FISH	1	27	41	1.50
		ALL PELAGICS	6	552	806	1.46
	TROLLING	PMUS TOTAL	1304	140821	212922	1.51
		MAHIMAHI	781	62715	100809	1.61
		WAHOO	693	38894	75405	1.94
		SHORTBILL SPEARFISH	1	23	29	1.25
		SAILFISH	18	960	1359	1.42
		MARLIN-UNSPECIFIED	249	37907	35150	0.93
		SHARKS	5	322	170	0.53
		TUNAS TOTAL	916	56853	80024	1.41
		PELAGICS-MISC. TOTAL	231	4449	6521	1.47
		RAINBOW RUNNER	50	743	1111	1.50
		MISC. TROLL FISH	195	3706	5410	1.46
		ALL PELAGICS	1675	202123	299467	1.48
	JIGGING	PMUS TOTAL	1	30	38	1.25
		MAHIMAHI	1	30	38	1.25
		PELAGICS-MISC. TOTAL	1	23	34	1.50
		MISC. TROLL FISH	1	23	34	1.50
		ALL PELAGICS	2	53	72	1.36
	BOTTOMFISH-SHALLOW	PMUS TOTAL	3	167	276	1.65
		MAHIMAHI	2	110	198	1.80
		WAHOO	1	33	66	2.00
		SHARKS	1	24	12	0.50
		TUNAS TOTAL	3	292	463	1.59
		PELAGICS-MISC. TOTAL	2	144	217	1.50
		RAINBOW RUNNER	1	135	203	1.50
		MISC. TROLL FISH	1	9	14	1.50
		ALL PELAGICS	6	603	956	1.58
	BOTTOMFISH-DEEP	PMUS TOTAL	1	112	0	0.00
		SHARKS	1	112	0	0.00
		ALL PELAGICS	1	112	0	0.00

GUAM ANNUAL COMMERCIAL LANDINGS OF PELAGICS
(CONTINUE)

ANNUAL SALES AND REVENUE
BY YEAR, METHOD, AND SPECIES

YEAR	FISHING METHOD	SPECIES	NUMBER TRIPS	WEIGHT (LBS)	REVENUE ($)	PRICE ($/LB)
1986	SPEAR	PMUS TOTAL	2	36	40	1.11
		SHARKS	2	36	40	1.11
		TUNAS TOTAL	2	14	21	1.50
		ALL PELAGICS	4	50	61	1.22
	NET	PMUS TOTAL	1	34	47	1.37
		MAHIMAHI	1	34	47	1.37
		ALL PELAGICS	1	34	47	1.37
	ALL GEARS	PMUS TOTAL	1314	141641	213991	1.51
		MAHIMAHI	789	63244	101604	1.61
		WAHOO	697	39013	75627	1.94
		SHORTBILL SPEARFISH	1	23	29	1.25
		SAILFISH	18	960	1359	1.42
		MARLIN-UNSPECIFIED	249	37907	35150	0.93
		SHARKS	9	494	222	0.45
		TUNAS TOTAL	923	57243	80605	1.41
		PELAGICS-MISC. TOTAL	235	4643	6813	1.47
		RAINBOW RUNNER	51	878	1314	1.50
		MISC. TROLL FISH	198	3765	5499	1.46
		ALL PELAGICS	1692	203527	301409	1.48

GUAM ANNUAL COMMERCIAL LANDINGS OF PELAGICS

ANNUAL SALES AND REVENUE
BY YEAR, METHOD, AND SPECIES

YEAR	FISHING METHOD	SPECIES	NUMBER TRIPS	WEIGHT (LBS)	REVENUE ($)	PRICE ($/LB)
1987	UNSPECIFIED	PMUS TOTAL	36	2313	2842	1.23
		MAHIMAHI	18	715	1233	1.72
		WAHOO	17	572	950	1.66
		MARLIN-UNSPECIFIED	5	898	595	0.66
		SHARKS	4	128	64	0.50
		TUNAS TOTAL	32	2282	3203	1.40
		PELAGICS-MISC. TOTAL	19	349	439	1.26
		RAINBOW RUNNER	1	7	10	1.50
		MISC. TROLL FISH	19	342	429	1.26
		ALL PELAGICS	62	4944	6484	1.31
	TROLLING	PMUS TOTAL	1304	126409	181679	1.44
		MAHIMAHI	726	46095	73263	1.59
		WAHOO	803	44612	77939	1.75
		SAILFISH	18	1248	1221	0.98
		MARLIN-UNSPECIFIED	195	33788	28923	0.86
		SHARKS	12	666	333	0.50
		TUNAS TOTAL	757	56568	84417	1.49
		PELAGICS-MISC. TOTAL	210	3828	5215	1.36
		RAINBOW RUNNER	40	504	762	1.51
		MISC. TROLL FISH	187	3324	4453	1.34
		ALL PELAGICS	1564	186805	271311	1.45
	JIGGING	PMUS TOTAL	1	26	13	0.50
		SHARKS	1	26	13	0.50
		PELAGICS-MISC. TOTAL	6	275	344	1.25
		MISC. TROLL FISH	6	275	344	1.25
		ALL PELAGICS	6	301	357	1.19
	LONGLINE-TUNA	PMUS TOTAL	1	328	328	1.00
		WAHOO	1	328	328	1.00
		TUNAS TOTAL	1	377	377	1.00
		ALL PELAGICS	1	705	705	1.00
	BOTTOMFISH-SHALLOW	PMUS TOTAL	2	76	70	0.92
		MAHIMAHI	1	32	48	1.50
		SHARKS	1	44	22	0.50
		TUNAS TOTAL	1	13	13	1.00
		ALL PELAGICS	3	89	83	0.94

GUAM ANNUAL COMMERCIAL LANDINGS OF PELAGICS
(CONTINUE)

ANNUAL SALES AND REVENUE
BY YEAR, METHOD, AND SPECIES

YEAR	FISHING METHOD	SPECIES	NUMBER TRIPS	WEIGHT (LBS)	REVENUE ($)	PRICE ($/LB)
1987	BOTTOMFISH-DEEP	PMUS TOTAL	1	161	197	1.23
		MAHIMAHI	1	45	67	1.50
		WAHOO	1	21	35	1.70
		MARLIN-UNSPECIFIED	1	95	95	1.00
		TUNAS TOTAL	4	282	312	1.11
		ALL PELAGICS	4	443	509	1.15
	SPEAR	TUNAS TOTAL	2	15	20	1.33
		PELAGICS-MISC. TOTAL	3	23	31	1.38
		MISC. TROLL FISH	3	23	31	1.38
		ALL PELAGICS	5	38	51	1.36
	OTHER	PMUS TOTAL	1	17	34	2.00
		WAHOO	1	17	34	2.00
		TUNAS TOTAL	3	588	1094	1.86
		PELAGICS-MISC. TOTAL	2	31	38	1.25
		MISC. TROLL FISH	2	31	38	1.25
		ALL PELAGICS	4	636	1166	1.83
	ALL GEARS	PMUS TOTAL	1344	129330	185163	1.43
		MAHIMAHI	745	46887	74611	1.59
		WAHOO	823	45550	79286	1.74
		SAILFISH	18	1248	1221	0.98
		MARLIN-UNSPECIFIED	201	34781	29613	0.85
		SHARKS	18	864	432	0.50
		TUNAS TOTAL	800	60125	89436	1.49
		PELAGICS-MISC. TOTAL	240	4506	6067	1.35
		RAINBOW RUNNER	41	511	772	1.51
		MISC. TROLL FISH	217	3995	5295	1.33
		ALL PELAGICS	1647	193961	280666	1.45

APPENDIX III

COMMONWEALTH OF THE NORTHERN MARIANA ISLANDS (CNMI)
ANNUAL COMMERCIAL LANDINGS OF PELAGICS
1979-87

DATA SOURCE:
CNMI DIVISION OF FISH AND WILDLIFE

CNMI ANNUAL COMMERCIAL LANDINGS OF PELAGICS

ANNUAL SALES AND REVENUE
BY YEAR, METHOD, AND SPECIES

YEAR	FISHING METHOD	SPECIES	NUMBER TRIPS	WEIGHT (LBS)	REVENUE ($)	PRICE ($/LB)
1979	UNSPECIFIED	PMUS TOTAL	155	16363	16170	0.99
		MAHIMAHI	104	11603	10562	0.91
		WAHOO	49	3788	4477	1.18
		MARLIN-UNSPECIFIED	6	972	1131	1.16
		TUNAS TOTAL	454	86078	72306	0.84
		PELAGICS-MISC. TOTAL	13	589	682	1.16
		RAINBOW RUNNER	4	318	379	1.19
		MISC. TROLL FISH	9	271	303	1.12
		ALL PELAGICS	556	103030	89158	0.87
1980	UNSPECIFIED	PMUS TOTAL	12	4186	6184	1.48
		MAHIMAHI	7	2150	3225	1.50
		WAHOO	11	1879	2802	1.49
		MARLIN-UNSPECIFIED	1	157	157	1.00
		TUNAS TOTAL	90	10595	11751	1.11
		PELAGICS-MISC. TOTAL	8	810	1227	1.51
		RAINBOW RUNNER	5	140	222	1.59
		MISC. TROLL FISH	7	670	1005	1.50
		ALL PELAGICS	94	15591	19162	1.23
1981	UNSPECIFIED	PMUS TOTAL	29	15866	19725	1.24
		MAHIMAHI	27	7008	8198	1.17
		WAHOO	13	6763	9163	1.35
		MARLIN-UNSPECIFIED	5	2015	2244	1.11
		SHARKS	2	80	120	1.50
		TUNAS TOTAL	88	66832	73607	1.10
		PELAGICS-MISC. TOTAL	11	7400	11226	1.52
		RAINBOW RUNNER	4	511	876	1.72
		MISC. TROLL FISH	10	6889	10350	1.50
		ALL PELAGICS	102	90098	104558	1.16
1982	UNSPECIFIED	PMUS TOTAL	30	18632	21571	1.16
		MAHIMAHI	17	12468	14791	1.19
		WAHOO	22	6124	6719	1.10
		MARLIN-UNSPECIFIED	1	10	31	3.08
		SHARKS	1	30	30	1.00
		TUNAS TOTAL	157	82214	85672	1.04
		PELAGICS-MISC. TOTAL	14	3357	4860	1.45
		RAINBOW RUNNER	9	3137	4615	1.47
		MISC. TROLL FISH	7	220	245	1.11
		ALL PELAGICS	163	104203	112103	1.08

CNMI ANNUAL COMMERCIAL LANDINGS OF PELAGICS

ANNUAL SALES AND REVENUE
BY YEAR, METHOD, AND SPECIES

YEAR	FISHING METHOD	SPECIES	NUMBER TRIPS	WEIGHT (LBS)	REVENUE ($)	PRICE ($/LB)
1983	UNSPECIFIED	PMUS TOTAL	324	21236	23248	1.09
		MAHIMAHI	204	11151	11316	1.01
		WAHOO	131	7008	8461	1.21
		SAILFISH	1	47	71	1.50
		MARLIN-UNSPECIFIED	23	3030	3400	1.12
		TUNAS TOTAL	1207	165600	164763	0.99
		PELAGICS-MISC. TOTAL	94	9953	10699	1.07
		RAINBOW RUNNER	23	818	994	1.21
		MISC. TROLL FISH	72	9135	9705	1.06
		ALL PELAGICS	1408	196789	198710	1.01
1984	UNSPECIFIED	PMUS TOTAL	296	18596	21635	1.16
		MAHIMAHI	128	6091	6026	0.99
		WAHOO	178	11270	14215	1.26
		MARLIN-UNSPECIFIED	12	1235	1394	1.13
		TUNAS TOTAL	1688	250966	238129	0.95
		PELAGICS-MISC. TOTAL	38	3347	4439	1.33
		RAINBOW RUNNER	14	527	615	1.17
		MISC. TROLL FISH	24	2820	3824	1.36
		ALL PELAGICS	1847	272909	264203	0.97
1985	UNSPECIFIED	PMUS TOTAL	374	26515	30306	1.14
		MAHIMAHI	194	10364	10726	1.03
		WAHOO	196	14601	17713	1.21
		SAILFISH	1	62	55	0.90
		MARLIN-UNSPECIFIED	6	1488	1812	1.22
		TUNAS TOTAL	1226	154473	158027	1.02
		PELAGICS-MISC. TOTAL	52	6390	7038	1.10
		RAINBOW RUNNER	15	516	555	1.08
		MISC. TROLL FISH	40	5874	6483	1.10
		ALL PELAGICS	1446	187378	195371	1.04
1986	UNSPECIFIED	PMUS TOTAL	249	23701	28392	1.20
		MAHIMAHI	155	14237	16633	1.17
		WAHOO	108	7250	9421	1.30
		SAILFISH	2	91	114	1.25
		MARLIN-UNSPECIFIED	18	2123	2224	1.05
		TUNAS TOTAL	1346	220123	235985	1.07
		PELAGICS-MISC. TOTAL	39	2144	2636	1.23
		RAINBOW RUNNER	22	655	842	1.29
		MISC. TROLL FISH	18	1489	1794	1.20
		ALL PELAGICS	1492	245968	267013	1.09

CNMI ANNUAL COMMERCIAL LANDINGS OF PELAGICS

ANNUAL SALES AND REVENUE
BY YEAR, METHOD, AND SPECIES

YEAR	FISHING METHOD	SPECIES	NUMBER TRIPS	WEIGHT (LBS)	REVENUE ($)	PRICE ($/LB)
1987	UNSPECIFIED	PMUS TOTAL	233	20360	25876	1.27
		MAHIMAHI	120	7602	9956	1.31
		WAHOO	112	10723	13582	1.27
		SAILFISH	1	67	107	1.60
		MARLIN-UNSPECIFIED	14	1968	2231	1.13
		TUNAS TOTAL	930	142673	163092	1.14
		PELAGICS-MISC. TOTAL	14	1022	1183	1.16
		RAINBOW RUNNER	9	526	684	1.30
		MISC. TROLL FISH	5	496	499	1.01
		ALL PELAGICS	1079	164055	190151	1.16